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DECEMBER 1976
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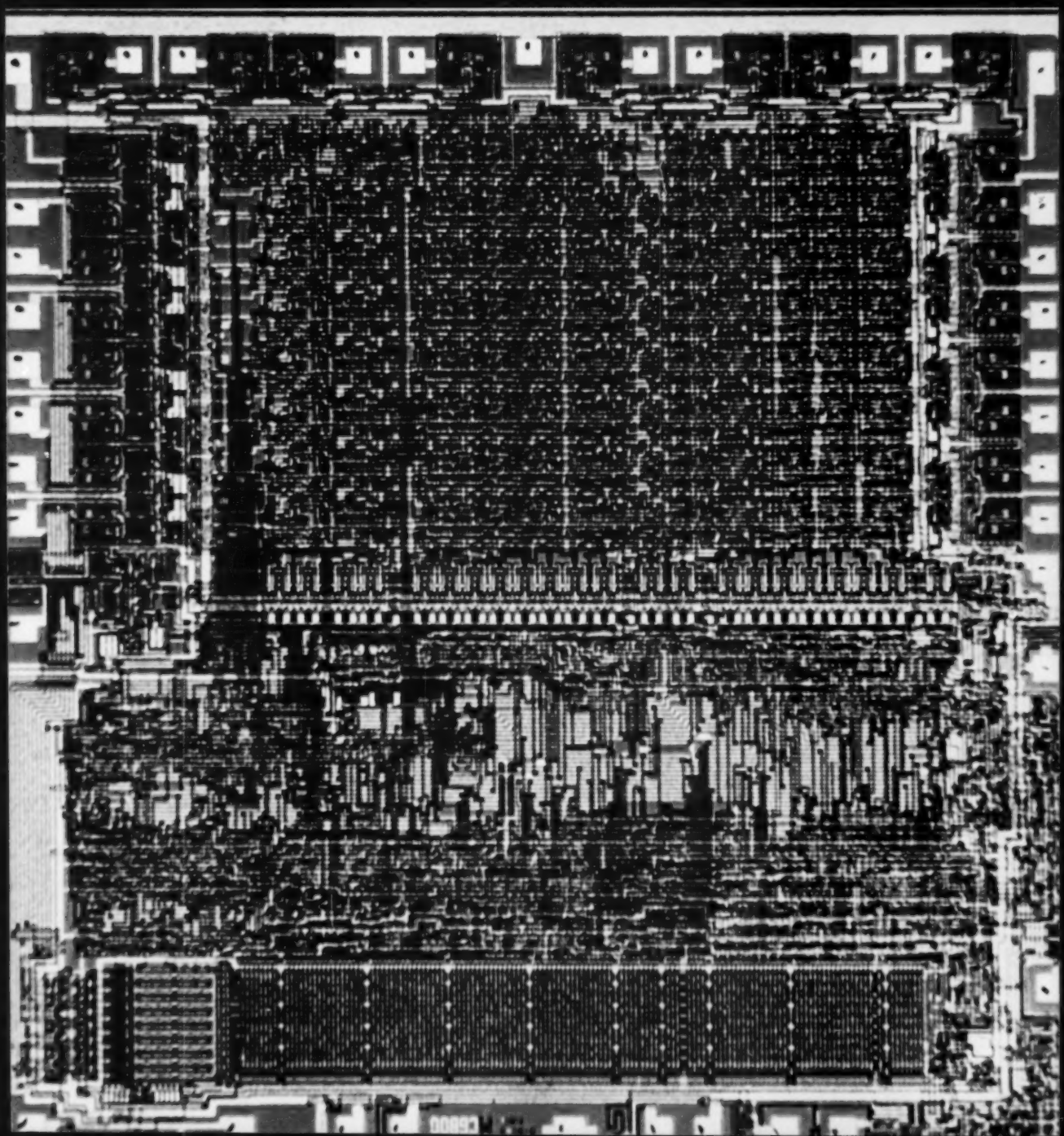

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Take hold of SSB with these two low cost twins. ICOM'S new portable **IC-202** and **IC-502** put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

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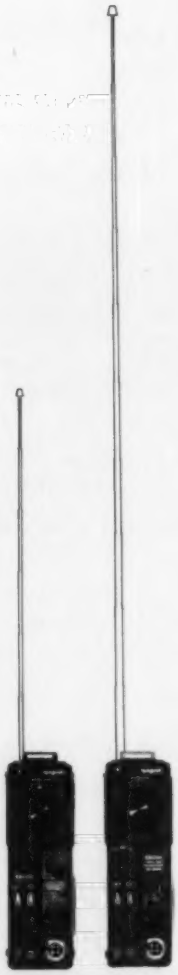

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 200KHz
VXO Tuning • 144.0, 144.2 + 2 More! • RIT!

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6 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 800KHz
VFO • RIT!

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COVER: The Motorola 6800.

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

73 SUFFERING?

Is *73* really dropping circulation, as ARRL recently reported in *HR Reports*? The fact is that *73*'s growth this year has been without precedent ... and both *HR* and *QST* know it. They are hearing this from readers, authors, dealers (who tell them that *73* is outselling their magazines in the radio stores), from newsstand wholesalers (who say the same thing) and, worst of all, from the advertisers.

The growth has been a pain ... but a most bearable one. We've just had to double the capacity of our computer system ... and it was supposed to hold us for a couple more years. We've had to do second printings of the April, September and possibly October issues because incoming subscriptions have been so far beyond our projections ... and that is horribly expensive. The staff has gone from 30 last year to 45 this year to handle subscriptions, mailing lists, promotions, artwork, writing, editing, printing ... etc.

Despite the rash of I/O articles in *73* this year, the subscriptions have been growing faster than ever before in our history (hey, did you see the microcomputer article in *QST* for August!). The *73* formula of lots of articles, few contest results, few activity reports, few PhD type of technical articles and tell it like it really is approach, which is more in vogue after Watergate, seems to work. Few but older hams seem to be buying the blind loyalty bit these days ... most want to see signs of responsiveness and relevancy.

Let's add up the pages of ads in the ham magazines for the last half of 1975 and the first half of 1976 for a direct comparison. Keep in mind that ads in *QST* cost about 10% more than those in *73*.

73	971 pages
QST	735 pages
HR	624 pages
CQ	306 pages

Perhaps the chart above will put things into perspective. It shows *73* with 32% more ads than *QST* (and a lot fatter magazine ... without all the contest results, SCM reports, and that stuff). After over 50 years as number one, this is a very bitter pill to swallow, and it is no wonder that there is some nervousness in Newington. Figures lie and liars figure, to coin a phrase.

TECHS'LL PROBABLY HATE ME

Not a few people have petitioned the FCC to open part or all of ten meters for Techs. It is a matter of religious significance to some Techs.

Since hamfests, conventions and computerfests are commercial affairs, 2m HTs should not be used for coordination. Here's one of the officials of PC-76 in the middle of a no-no. This sort of thing would be okay using CB, but not ham radio.

At the present time I am neither for nor against the idea. However, I would like to see someone come up with a good reasonable argument which would convince me that it was a valid idea.

Yes, I think I know all of the arguments ... but I may have missed some. Ten needs activity ... no question about it. But blessed if anyone has come up with any data which indicates even remotely that Techs will use ten meters if we open it for them. All that data I've seen so far points the other way.

Six was the biggy a few years back ... right? You could find about 90% of the active Techs chewing away on six ... maybe 95%. Then some chap (prizes if you know who) started really pushing two meter FM and repeaters and got things perking up there. Instant flushing of six ... which turned into a ghost band. Now 95% of the active Techs were on two meters, with a thin scattering on six, 450 ... and even a half dozen or so on 220 MHz.

From that, one might be tempted to suspect that Techs (like all other classes of hams) tend to go where the action is. OK ... so what about ten meters? Well, with over 200,000 licensed amateurs with tickets which do permit them to operate on ten ... and with a mere handful doing same, why on earth should we expect Techs to suddenly reverse their practice of ignoring inactive bands? When you have a good explanation for that, let me know and you'll find a heavy hand pushing for Techs on ten.

If Techs are so great at helping keep bands busy, where are they on 220 MHz? Where are they on six meters? You know where they are ... they are on two meters. And I don't want to hear from the tiny band of pioneering Techs who are out there trying to shovel coal up the chute (to coin a phrase), fighting a tough battle to keep *something* going on bands other than two. Fair is fair, fellows.

WARC – WHAT YOU CAN DO

Okay, so most of us are worried about what might happen at the next ITU conference in 1979. Again there is every reason to worry, particularly if you have any real knowledge of where amateur radio stands with other countries.

As I mentioned in my October editorial, the only chance that I see

Continued on page 176

ANNOUNCING AN EXCITING NEW 2-METER TRANSCEIVER FROM KENWOOD

the TR-7400A

Featuring Kenwood's New and Unique CONTINUOUS TONE CODED SQUELCH SYSTEM

4 MHz BAND COVERAGE

25 WATT OUTPUT

FULLY SYNTHESIZED

UNIQUE SQUELCH SYSTEM
The TR-7400A may be used on your favorite repeater, no matter what type of squelch system is used. The continuous tone coded squelch (CTCS) may be used for both transmit and receive or for transmit only. Tone burst operation may also be used.

SYNTHESIZED, 800 CHANNELS
The phase-locked loop (PLL) frequency synthesizer in the TR-7400A divides the 4 MHz bandwidth into 400 channels at intervals of 10 KHz. The frequency may be offset 5 KHz higher with the push of a button, thus providing 800 discrete channels.

REPEATER OFFSET
A convenient front panel switch offsets the transmit frequency of the TR-7400A up OR down 600 KHz for standard repeater operation. This offset circuit uses digital technology to provide a highly stable offset frequency without spurious response. A dual color LED indicates the direction of offset from the displayed receive frequency.

OUTSTANDING RECEIVER PERFORMANCE
Large-sized helical resonators with high Q minimize undesirable interference from outside the 2-meter band. The large helical resonators, 2-pole 10.7 MHz monolithic crystal filter, and MOSFET front-end circuitry combine to give outstanding receiver performance.

TONE PAD CAPABILITY
A jack is provided to allow convenient connection of a tone pad to the TR-7400A.

FINAL PROTECTION CIRCUIT
The final transistor in the TR-7400A is protected from antenna impedance mismatch. Excessive reflected power reduces the amount of drive to the final transistor rather than turning off the final stage. This practical feature allows continued safe operation at a reduced power level whether the antenna system becomes opened or shorted.

Specifications TR-7400A

- Range: 144.00 MHz to 147.995 MHz
- Mode: FM
- 800 Channels: 5 KHz spaced
- Sensitivity: Better than 0.4 uV for 20 dB quieting
  Better than 1 uV for 30 dB S/N
- Squelch Sensitivity: Better than 0.25 uV
- Selectivity: 12 KHz at −6 dB down
  40 KHz at −70 dB down
- Image Rejection: Better than −70 dB
- Spurious Interference: Better than −60 dB
- Intermodulation: Better than 66 dB
- Receive System: Double conversion
- First IF: 10.7 MHz
- Second IF: 455 KHz
- Audio Output: More than 1.5 Watts (8 ohm load)
- RF Output Power: 25 Watts (High)
  5-15 Watts (Low-adjustable)
- Antenna Impedance: 50 ohms
- Frequency Deviation: ±5 KHz
- Spurious Response: Better than −60 dB
- Tone Pad Input Impedance: 600 ohms
- Tone Burst Duration: 0.5 to 1.0 sec.
- CTCS Range: 88.5 Hz to 156.7 Hz
- Microphone: Dynamic, with PTT switch, 500 ohms
- Voltage: 11.5 to 16.0V DC (13.8V DC nominal)
- Current Drain: Less than 1A in receive (no input signal)
- Current Drain: Less than 8A in transmit
- Polarity: Negative ground
- Temperature Range: −20 to +50 degrees C
- Dimensions: 182 mm (7-3/16") wide
  270 mm (10-5/8") deep
  74 mm (2-7/8") high
- Net Weight: Approximately 2.8 kg (6.2 lbs.)

TRIO-KENWOOD COMMUNICATIONS INC
116 EAST ALONDRA, GARDENA, CA 90248

KENWOOD
...pacesetter in amateur radio

BE MY GUEST

visiting views from around the globe

Little...

Every day records are falling. Divers are setting new underwater poker playing records. Jets are crossing the Atlantic at supersonic speed. A group of Nashua, New Hampshire folks recently set the world's record for rocking chair rocking. And out in a small midwestern town this summer, a five year old boy has earned a Novice class amateur radio license. It boggles the mind.

Neil "Rusty" Rapp WN9VPG of Vincennes, Indiana will only start first grade this fall. At age four the boy's reading ability was estimated to be at the fifth grade level. His Novice code test features inch high letters, and a better score (103) than his father. Rusty learned the code in only seven weeks and passed his theory exam in about half an hour. Already he's bored with the Novice bands, and is studying hard for his General.

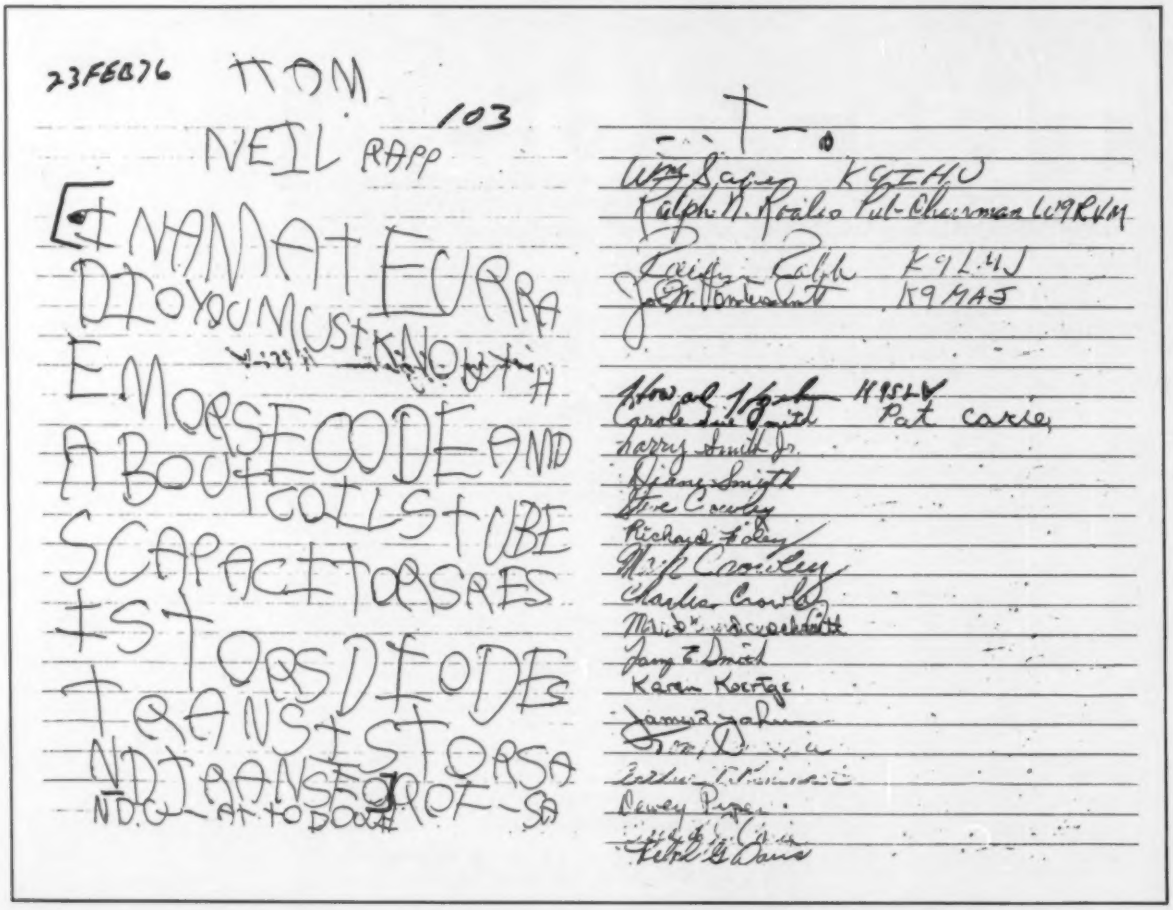
As near as we can tell, the old world's record for youngest ham was Gary Lewis WN7BBJ. Lewis was seven when he got his license, but the *Callbook* says he's no longer licensed, or has another call. A fellow in Washington now holds N7BBJ.

Rusty began on the CB bands, after his dad, now a Novice, bought a CB radio. Rusty caught on fast, memorizing handles and callsigns and becoming a local legend on channel 13. He used the handle "Little Shadow."

At Christmas time, the elder Rapp dusted off a code key and oscillator and decided to get into ham radio. Father and son had been practicing for several weeks when they spotted an ad in the local paper: The Old Post Office Amateur Radio Society was offering Novice classes, the minimum age requirement being 10.

The first night, Del Rapp left his son home, afraid of the age limit. But there was a ten year old girl enrolled, so the next week it was Rusty's chance. Three weeks later, father passed the code test, but Rusty failed. He'd been told not to turn over his paper . . . but since the boy wrote in such big letters, he'd run out of paper and couldn't copy enough characters.

Rusty, according to his mother,



cried until midnight ... and there were doubts whether he ought to continue. Two weeks later, the code hurdle was eliminated, thanks to the watchful eyes and ears of Bill Sage K9IHU, the club code instructor.

Then it was onto theory and it was tough going. Rusty's mom decided to come up with a game, so the boy could memorize the questions and answers "backwards and forwards." They put the questions on one set of cards and the answers on another. Father and son then questioned each other with gusto, using pennies and then peanuts to reward correct answers.

The Rapps must have gone through a lot of peanuts, because it turned out the FCC lost Rusty's application. More than three months after the code test, it was finally time for theory.

It must have been quite a sight, a five year old boy poring over the exam questions ... filling out the computer answer form. How many of us have been there, with years of schooling and hours of study, only to fail and have to try another day. Theory instructor Howard Hazelman K9SLV probably still doesn't believe it. When Rusty passed his code test, the entire class signed his exam paper ... because the instructor feared no one would believe a five year old boy could pass.

You can imagine the look on K3DIF's face when he gave WN9VPG his first QSO on 15 meters. It turned out K3DIF worked for Associated Press in Washington, DC, and the story of the world's youngest ham was on its way into print. A half dozen radio and newspaper stories followed. Rusty even heard from First Mama Betty Ford, who replied with a big 10-4 and a form letter signed, "Nice modulating with you!" (The White House is apparently short of ham radio form letters.)

Photo by Paul Willis

One thing's sure: Rusty Rapp's achievement should be an inspiration to all of us, whether we be Novices seeking General class licenses, CBers trying to get into hamming, or Advanced licensees struggling to get the code speed up to 20 for the Extra. There is something to that ancient saying, "And a little child shall lead them ..." Meanwhile, I'm firing up on 21.120 MHz this Sunday for the Old Post Novice Net, at midnight GMT, hoping to reach that five year old Novice and taste a bit of the world's youngest fist.

... News

A recent report to the Office of Telecommunications Policy, Executive Office of the President, warns of the potential for breakdown of the federal regulatory system in the face of rapidly developing telecommunications technology. Prepared by Arthur D. Little, Inc., the report foresees the headlong growth of Citizens Band radio resulting in new criminal techniques and the Postal Service threatened with obsolescence. Even AT&T's gaining a monopoly of all broadband distribution to the home is among other possible impacts of technological change.

Martin Ernst, director of the study, says the report is not a prediction, but a warning of the kinds of chaos that could result if the status quo is maintained. "It's not a matter of more regulations," he stated, "but of how telecommunications should be regulated. Much of the technological change we assessed is already well on its way. It can't easily be turned back. The regulatory framework has to be rethought to deal with the possible social impacts," he explained. "Over-regulation certainly is not the answer. In fact, sections of our study focus on the dangers of too much regulation, especially if it cannot in practice be enforced."

Commissioned by the Office of Telecommunications Policy as the first step in the process of planning for the impacts of telecommunications change, the report consists of five scenarios. They develop possible, though not necessarily likely, chains of events in such fields as mail delivery, CB usage, broadcast distribution, broadband communications, and education. The scenarios were developed to dramatize a broad range of possible impacts on individuals, society as a whole, and the economy.

Pervasiveness of Telecommunications

The visible forms of telecommunications (telephones, television, radio) give few clues to its pervasiveness. The invisible nature of its more critical aspects (electronic networks, communications satellites, cable systems, and other operations which make these things possible) has led to its casual acceptance, according to the report. "Most users are unaware, for example, of the technical, economic, and political considerations that determined specifications for equipment such as television sets before they could be marketed or what alternative performance possibilities were and are available. Not only the costs and quality of equipment, but even personal safety and national security can be determined by remote decisions that are difficult for all but the most experienced and well informed to comprehend fully," the report states. Similarly, few of the recipients of electronically transmitted Social Security payments, Citizens Band radio enthusiasts, or cable TV customers are aware of the mechanisms involved and the potential for sweeping change represented therein.

With the possible exception of transportation, the report points out that telecommunications has no rival in the degree to which it is a part of American life. Repercussions of seemingly isolated and relatively unimportant decisions regarding a single aspect of it can affect a broad range of human activities. For example, a CB radio frequency band decision to open more channels would affect imports and thus, among other effects, change the balance of payments. It also could affect treaties with other nations, notably Canada.

The meteoric growth of Citizens Band radio already has overcrowded

the channels available to it. This could affect international relations because the use of present frequencies during periods of high sunspot activity, such as that anticipated in 1979, could interfere with radio operations in other countries where amateur radio is more rigidly controlled. In that context, the study notes, no other nation has permitted access to a Citizens Band because of the many and difficult problems such access creates.

Outcome of CB Radio Boom

The study team developed a scenario of possible events arising from the proliferating use of CB radios. The team believes that hoards of new users and additional uses could in the not too distant future turn the present situation into sheer chaos unless a workable policy is developed. Present policy is the responsibility of the FCC, which has neither the resources nor mandate for enforcement. One typical issue is freedom of speech as affected by FCC controls. CB is already used in organized demonstrations; this raises the question of the legality of police use of jamming to maintain law and order in riot situations. Privacy and the use of scramblers versus monitoring for illicit use is another example. At least eight federal government agencies (FCC, OTP, Commerce, State, Justice, Coast Guard, Defense, Interior) and local governments will have to contend with the potential impact of CB.

USPS Headed for Obsolescence?

Already beleaguered, the United States Postal Service (USPS) is perceived by the report as one of the more vulnerable organizations in the path of the telecommunications onslaught. Despite the vital function it has performed for society for two centuries, the USPS has limited freedom with which to combat the encroachments which have begun. Electronic funds transfer techniques already in use can significantly substitute for the 35 percent of all mail (two thirds of first class) accounted for by financial transactions (orders, invoices, bills and payments). Because Postal Service operating costs reflect the number of deliveries which need to be made, not the volume carried, the loss will disproportionately affect USPS revenues.

A second threat lies in the growth of digital data and facsimile networks which might ultimately be used for a large portion of intra- and inter-business messages. With advancements like these making mail service obsolete for many business purposes, massive subsidization might be required to maintain national mail service for individuals. This could result in very much steeper postal rates (approaching 35¢ an ounce for first class mail in the mid 1980s), the need to pick up mail from central drops, or else pay for deliveries.

The USPS can respond with its own electronic transmission to move mail from one location to another. However, the most profitable portion is what is handled by telecommunications companies which can avoid the expensive physical delivery process. Unless the USPS is prepared and permitted to compete directly with private industry, it must build its business out of the least economically desirable markets.

Television Struggle

A third scenario deals with the possible outcome of an attenuated struggle between "free" broadcast television and cable and pay television. The potential for competitive advantage afforded by the use of satellites might ultimately lead to the elimination of local TV broadcast stations. Alternatively, current research into the use of optic fibers could lead to telephone companies becoming the most logical providers of home television access in the long term. Regulatory policy will continue to be a key factor in alternative developments and any subsequent change in the television industry's infrastructure. The FCC and other regulatory agencies now face increasing conflict as technology offers new opportunities that favor first one telecommunications industry sector and then another.

Another scenario explores the possibility of two-way broadband communications being extended to cover individual households, permitting access from homes to libraries, data bases, education, entertainment, computers, and other facilities. A fifth scenario investigates the interface between public services and private enterprise in the provision of telecommunications services for health, education, and government communication needs.

Arthur D. Little, Inc.
Cambridge MA

The Persuader

A Boston psychiatrist says CB radio's effect on personality may be too new a phenomenon to draw any accurate conclusions. Dr. Mark Walter of the McLean Hospital in Belmont says it's a matter of people feeling the power and anonymity of the microphone.

Walter told the *Boston Globe*, "It's really a new variation of an old thing . . . we do know that ham radio operators are often the sort of people who enjoy being in a room alone with the power of talking out to the world. They want to reach out and be in touch with people but keep an emotional distance from the same people."

FCC regional director Gerard Sarno goes a step further. Sarno characterizes the average CBer as a "nitwit" who becomes "obsessed with the feeling that they have no other purpose in life other than to transmit on a CB radio. It gives them a source of identity they never had before. And suddenly, if they're criticized by someone else, watch out for them."

Both men were commenting on a recent shooting incident in Boston. Newspaper accounts reported that two friends were chatting over CB when a third person broke in with some flack. "You come over here and say that face to face," one of the friends shot back, adding that he lived at an address in the Back Bay section.

A short time later, in the wee hours, a car showed up outside the Back Bay address. A man jumped out, yelling; "Here I am. Now what are you going to do about it?"

A 44 year old businessman ran out into the street to answer the challenger. Brandishing a .38 caliber revolver, he smashed one of the car windows . . . and pumped a slug into the CB set under the dash, demolishing it. "There, that'll teach you," he shouted back, as he ran into his house.

Carnival Time

The combined effort of amateur radio operators in two states, the Red Cross, and others, has resulted in the return of a missing boy to his worried mother.

Mrs. Judy Lever, Mt. Holly, Vt., had high praise for the amateur radio operators, who located her son, Mark, 13, when others had not been able to find him.

Amateur radio operators in Vermont, including Fern Adams W1YYU, North Clarendon, William Dimick WA1OHB, Rutland, and Mildred Doe K1BQB, Bellows Falls, notified New Hampshire operators that the boy was missing and possibly traveling with an amusement company in New Hampshire or Maine.

"I have a friend who is a ham operator," Mrs. Lever said. "Her set was not working, but she contacted friends, who immediately contacted others, among them Mr. Prescott (J. Longdon Prescott, amateur radio operator and disaster chairman for the Kearsarge Chapter, American Red Cross, in Franklin). We told them we were looking for a carnival, and within two hours they had located the company and my son. I am very grateful to them for the fine job they did."

Amateur activities were coordinated by Edwin Antz of Danbury, net manager of the Granite State Amateur Radio Network, and the WR1ABU repeater, located in Concord.

The particular company Mark was traveling with was difficult to trace, as they moved often. The help of Mrs. Linda Hebert, Carver Street, West Franklin, and amusement publications, determined that the boy was with an amusement company in Calais, Maine.

The Red Cross and company officials made arrangements to transport Mark back to Mt. Holly, but a misunderstanding about time resulted in Mark taking a bus home on Monday.

Mrs. Lever was happy to have her boy back home, and Mrs. Hebert has been commended by the Red Cross for her efforts in locating the missing boy.

Reprinted from the Manchester *(N.H.)* Union Leader, *July 21, 1976.*

Report from Boston

The Federation of Eastern Massachusetts Amateur Radio Associations has been putting on conventions for years now. There have been those bigger than this year's version, held at the downtown Boston Statler Hilton. Most of the biggies had come to the now departed New Ocean House in Swampscott, but that was before the CB explosion.

Not that the CB influence hurt attendance much. A lot of CBers turned out, just to see why all those folks were breaking channel 19 to find the hotel. Convention officials said they had a record day Sunday . . . but the exhibitors were another story. Less than fifty showed up, and five of those were computer oriented. Several manufacturers said they were using the same displays at CB conventions, by simply inserting new signs (to change that loaded whip exhibit from 27 to 144 MHz). The economics of the CB boom then became one of the unspoken exhibitors.

A highlight of the weekend was WR1ACO's long distance link with WR6ABM in the San Francisco Bay Area. The Malden association has done it before, with a July 4th spectacular that linked Boston with Hawaii and Philadelphia. But this time, instead of the club paying the bill, the cost (about $150) will be borne by a small group of Boston FMers. A high point (or low point, depending on how you look at it) was one poor fellow's query, aired on both coasts, whether it was just conditions or what? He even signed his call! Plans to broadcast remarks by ARRL President Harry Dannals W2TUK during the convention banquet had to be scrapped, because of problems on the West Coast side. But once the system was debugged, all went well. WR6ABM, incidentally, is microprocessor controlled.

Back at the convention . . . Heath was introducing its new synthesized 2m FM rig, the HW-2036. An earlier attempt, you'll remember, was recalled because of spur problems, although company engineers say the earlier model would have worked, if most hams had access to spectrum analyzers. Heath says the new version puts spurs (within 20 MHz of carrier frequency) down 70 dB. It's due before Christmas.

A close competitor will be the Icom IC-22S, a 22 channel synthesized 2m FM rig which features a diode matrix system for user setup of desired channels. The Icom was the talk of the convention, with dealers taking scores of orders and much speculation about the new model's impact on the 2m market. It looks like the 22S will become a modifier's delight, with several schemes already afoot to externally program the synthesizer through outside switching. Company officials say demand is so great that it could be months before the orders are filled. But they continue to deny that the IC-230 is about to follow the IC-22A into oblivion. Rumors nevertheless persist that Tempo's VHF 1 digital readout rig will soon have an Icom competitor.

On the HF side . . . Kenwood-Trio kept a constant crowd with their new TS-820, despite the fact not one dealer at the convention had any to sell. Kenwood officials noted increasing pressure for them to sell direct, a violation of longstanding company policy, and could only urge people to keep plugging at their local dealers. CushCraft introduced a new four element tri-band beam, model ATB-34. With an 18' boom and 30'8" maximum element length, it's bound to stir up the tri-band market. One real plus is CushCraft's plan to include a 1-1 balun as part of the deal. The first ones ought to be coming off the assembly line soon.

Hy-Gain has apparently applied some of its CB R&D money to the ham bands, with a new line of VHF-UHF mobile antennas. They use an etched copper loading coil on a PC board and even offer one that covers 6 and 2m. The idea first appeared with Hy-Gain CB antennas.

One of the biggest disappointments had to be the convention flea market. For two days some die-hards hung in there, but the downtown location took its toll, since the pickings were so poor. To say the least, Boston was no bargain for flea marketeers.

All that aside, it was a pretty good convention. All the elements (except the fleas) were there . . . and the Boston crew came through with their usual outstanding prize program (everything from a weather station kit to a TR-4C). One big change was the mounting influence of microprocessor hamming. The seminar schedule was loaded with it, and, with 3 retailers and an equal number of manufacturers in evidence, it's apparent that ham radio is in for another revolution. Typically it's in for another round of controversy as well, as the debate over microprocessors gets underway in earnest.

Warren Elly WA1GUD/1
Bennington NH

Hams to the Rescue

Using the airwaves and lots of goodwill, a band of local ham radio operators cut through international red tape to airlift a seriously ill American from Mexicali to a hospital here.

Robert Lake Carden Jr., 27, of New York state, was in Veterans Hospital today after the San Diego County Amateur Radio Council put up $1,700 bail for alleged crimes in Mexico and flew him here in a rented plane piloted by a local ham.

Members of the club got the original bail reduced from $9,000 to $1,700; a member put up all the money at once pending pledges that were made over the radio.

Another member rented a four-seater plane and flew down to Mexicali yesterday, the bail was paid and the Mexican Red Cross rushed Carden to the border at Calexico.

The Fire Department there supplied another ambulance which sped to the airport, where Carden was placed in the plane and flown to Montgomery Field. He said very little on the flight.

An ambulance service waived its customary fee and took the heavily sedated man to the hospital.

Doctors there were conducting a series of tests to determine the exact nature of Carden's illness. He had told some of the hams that he was dying of throat cancer and could not get proper treatment in Mexicali.

Carden's flight to freedom began a few weeks ago as he lay in the general hospital at Mexicali. He told Umberto Wang, a medical student, that he was dying of throat cancer and wanted American ham operators to contact his mother in New York.

Wang happens to be a ham, and passed the message along to a fellow Mexicali ham who he knew was in contact with hams on this side of the border.

Jim Smith of Ocotillo, who belongs to the San Diego ham outfit, picked up the call and relayed it to many of the 4,000 members of the group. One of them called Carden's parents, who said they had no money to help.

Interest in the issue spread quickly, and a "Rescue Robert" fund was established with the goal of bringing the man out of Mexico. San Diego hams appealed for help to the U.S. consulate in Tijuana, but were unable to obtain assistance.

Paul Hower, a local ham who piloted the plane yesterday, explained how Carden came to be in custody according to what the man told Smith. The Ocotillo man visited Carden often during his many trips to discuss the matter with Mexican officials.

Carden told Smith he lives in Lockport, N.Y., and served three years in the Marine Corps. He was on the West Coast in April visiting friends.

In Barstow, he met a man and two girls who invited him to go to Mexico with them, he said, and the group visited border cities.

One of the girls paid for the food and lodging of the group with credit cards she said belonged to her mother, Carden said. However, a Mexicali hotelman got suspicious and called police.

The other couple had fled, but Carden and one girl were arrested. The girl was freed because she was 16; Carden was jailed.

But he was hospitalized when he became ill with what he said was cancer of the throat. He said that he had been fed intravenously for 60 days and would die if not treated in this country.

Johnny Johnston, a ham who got involved in the case, went to Mexicali

Continued on page 89

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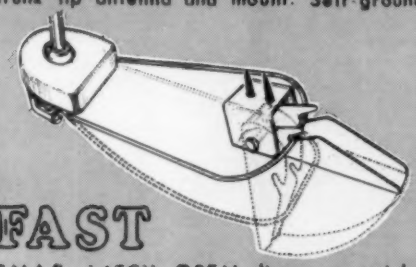

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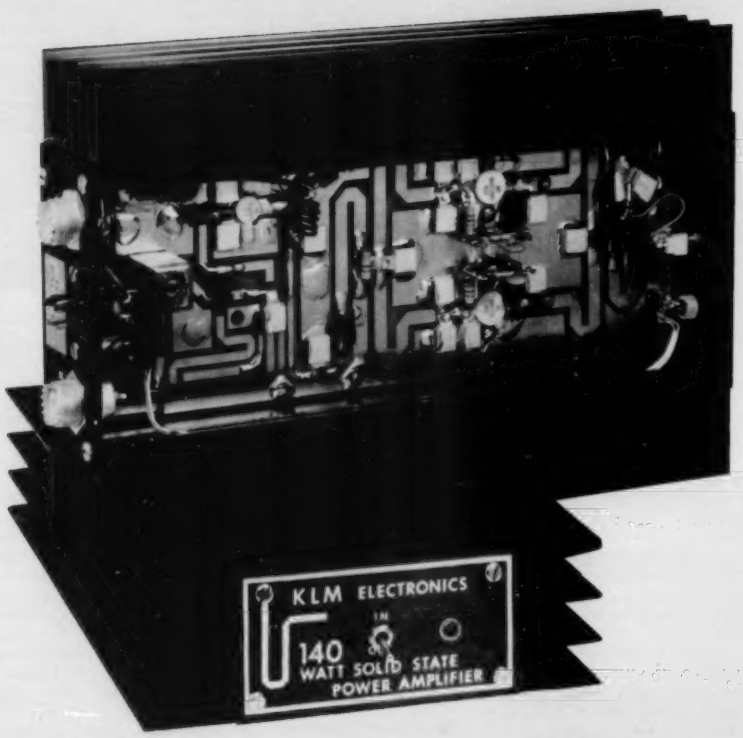

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144-148	PA2-12B	1-4	12	2	A*	44.95
"	PA2-70B	1-4	70	10	C*	149.95
"	PA2-70BL◇	1-4	70	10	C*	159.95
"	PA2-140B◇	1-4	140	20	D*	219.95
"	PA10-40B	5-15	40	5	B*	79.95
"	PA10-40BL◇	5-15	40	5	B*	89.50
"	PA10-70B	5-15	70	8	C*	129.95
"	PA10-70BL◇	5-15	70	8	C*	139.95
"	PA10-80BL◇	5-15	80	10	C*	149.95
"	PA10-140B	5-15	140	18	D*	189.95
"	PA10-140BL◇	5-15	140	18	D*	199.95
"	PA10-160BL◇	5-15	160	22	D*	209.95
"	PA30-140B	15-45	140	15	D*	169.95
"	PA30-140BL◇	15-45	140	15	D*	179.95
219-226	PA2-70BC	1-4	70	10	C*	169.95
"	PA10-60BC	5-15	60	8	C*	149.95
"	PA30-120BC	15-45	120	15	D*	189.95
400-470	PA2-40C	1-4	40	7	C*	149.95
"	PA10-35C	5-15	35	6	B*	119.95
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"	PA10-70C	5-15	70	13	D*	225.95
"	PA10-70CL◇	5-15	70	18	D*	245.95

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Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

We have probably heard the nation of Israel referred to as the "Garden" of the Middle East, in that from this "desert" the Israel people have carved a flourishing land of plenty — a place that they call a "land of milk and honey." It seems as though it's not only the products of "old Mother Nature" that have come to flourish there, but VHF and VHF repeaters as well. How do I come to make this statement? Thanks to Yuval 4X4FN, recently portable 6, Looking West has the opportunity of bringing you a bit of information as to what Israeli amateurs are doing with two meters.

Yuval was on a trip to the southland when I encountered him on the WR6ABB repeater system here in Los Angeles. To be a bit more specific, he was en route from Los Angeles to San Diego and had a lot of time to pass as he headed south on I-405. After introductions and the "warm PARC welcome," I began to question Yuval about what is happening VHF-wise in his homeland, with the following being a summary of the information that came forth as a result.

At present there are at least three operative two meter systems, all operating on the same channel pair of 145.175 in and 145.775 out. One of the three operational systems is located in the area of the city of Haifa, another near Beersheba, and the last at Kibbutz Sasa (serving the Upper Galilee). A fourth system, also on the same channel pair, was being prepared for the Tel Aviv area when Yuval departed for the USA. Whether it is operational or not at this writing is unknown.

Now, unlike repeaters here in the USA, Israeli repeaters do not have distinctive callsigns such as the WRs we have come to know, and most simply operate under the call of the amateur or amateurs responsible for the installation of the system. Most do not have auto-ID, so you sort of have to kerchunk a system to see if it's on the air. According to Yuval, "visitors" using these systems are quite welcome, and American amateurs planning to visit Israel can obtain a permit to operate by contacting the appropriate ministry prior to departure to secure a permit. I believe that it was the Ministry of Communication, but I am not too sure since by this point signals were beginning to drop out. Possibly it was the Ministry of Transportation; I will try to clarify this point in the near future.

So much for repeater operation, but for this story. Simplex (direct) is also alive and well and growing rapidly. The prime simplex channel is the repeater output frequency of 145.775, but when that channel is busy you will find the overflow sitting on both 145.25 and 145.50, in that order. In the Tel Aviv area, I am told that simplex is busy most of the day and well into the evening. Language barrier? Not according to Yuval, since he says that most Israeli amateurs speak fluent English. And with this you have a quick glance at what VHF-minded amateurs elsewhere in the world are up to — a chance to glimpse at the achievements of others in the worldwide community we know as amateur radio. Now on to what we promised last month, or at least close to it: a glimpse at a real great guy on a trip here to the southland, John B. Johnston K3BNS, Chief of the FCC's Amateur and Citizens Division.

In case you have not guessed it by the foregoing, I happen to like John. In my personal opinion he is the best thing to happen to amateur radio in the many years that I have been a part of it. What he has accomplished on our behalf in just one short year is something that he and we can all be proud of. Thanks to his trust and belief in us, and his willingness to press for more freedom from regulation so that amateur radio can again grow and prosper, he will long be remembered within our ranks.

San Fernando Valley ARC President Fred Killitz WB6EJG formally welcomes John.

I had hoped to arrange a private interview with John while he was here in L.A., and had even approached Capt. Dick McKay K6VGP, John's host, on the matter. Unfortunately, due to schedule conflicts on my part, no feasible time could be found. The simple fact was that I had to put in a lot of overtime at work, and that limited my free time a bit. However, I found myself in a position to attend and participate in two evening open meetings that John had with area amateurs. Before continuing, though, and in deference to John, I must say that the format I will follow is that of transcribing from tape both the questions and John's answers, close to verbatim. These questions were posed by members and visitors to meetings sponsored by the Palisades Amateur Radio Club in Culver City and the San Fernando Valley Radio Club in Panorama City/Van Nuys, during the week of August 16.

First, let us set the scene. The place is the Veterans Memorial Hall in Culver City, California, the evening of August 18th. Dan Deckert WA6FQC, President of the Palisades Amateur Radio Club, addresses the assembled multitude. Dan proudly welcomes John to this meeting on behalf of PARC, and introduces him to the audience. This introduction is followed by a 3 minute standing ovation — a totally spontaneous showing of affection toward their friend from back East.

John began the formal part of his presentation, after greeting the crowd, by showing a series of color slides that told about himself: his specific interests in amateur radio, his station, the radio clubs he has and does belong to, and some of his friends within the amateur community. It was a "here I am, come get to know me as a fellow ham" presentation that gave us all a bit more insight into this "man from the FCC." Then came the part that most of us had awaited — the open format question and answer session. All questions were made from the floor by fellow amateurs just like you and me. The following are what I feel are the pertinent subjects covered in both the meetings I attended and taped.

Question: What about 1979? (Questioner was referring to where amateur radio will stand at this upcoming conference.)

John: We probably have about the best organized working group of all the groups and I say that because Merle Glunt, who is the ARRL man working on that, who used to work for the FCC and is possibly one of our top international negotiators, says that he attends all the meetings: broadcast, common carrier, and so forth. He says we probably have the best organized group, and I also know that when we did our report — we have to file with the Library of Congress — as for the amateur, we have the best looking report, too.

However, that's to establish the FCC position, and I think, shortly, before too many months, there will be a first of a series of Notices of Inquiry coming out with what the FCC position is. I don't think we're going to get everything in that notice that the amateurs asked for, because we asked for an awful lot. We asked for all of our present bands; for our present bands to be expanded; for some new bands; and, you know, really sort of gorged ourselves writing to Santa Claus. But the fellows working on the group have done a fantastic job. Apparently they're working on a new document — that's the amateur group — to further support and justify our need for those frequencies.

Some of them (frequencies) are in trouble. I guess you've heard about the one that's probably nearest and dearest to your hearts, 146 to 148 MHz, which is not an amateur band in some parts of the world. I believe that the maritime or aviation is after that, looking for more VHF frequencies. 75 meters, 3.9 to 4.0 — the broadcasters have their eyes on that. The broadcasters also have their eyes on 160 meters, so, who knows? It's going to be an uphill fight all the way.

Question: This docket 20777, the bandwidth/mode docket. What is the purpose behind it?

John: We are trying to deregulate the service as much as possible. All regulatory agencies are under great pressure to deregulate and, looking around the FCC, the only service that was really asking for deregulation was the amateur service.

One of the big problems amateur radio has always had with the Commission has been when a new mode came along — a new teletype mode or whatever it is. Slow scan came along; that was a problem for a while. The Commission felt that in order to authorize someone to use that mode, they (the Commission) would have to have the equipment to monitor and intercept those messages to make sure they were consistent with the rules.

I tried to make a giant leap forward; I said that, well, maybe that thinking was good for the 20s or 30s or something like that, but it's harder and harder to get the appropriations to buy that equipment, particularly when you say you want to use it to monitor amateur transmissions — it's really tough to get the budget for that. So, let's try and go with something simpler. Maybe not talk about emissions — talk about bandwidth, though it's recognized that amateurs don't have a great capability in measuring bandwidth. But maybe if they had the requirement, things would develop. Maybe not. But then it would open up a whole new future, especially for the experimenters who wanted to experiment with new types (of emissions), and maybe amateur

radio could bring new modes of communication to the other services, develop new modes of communication.

The comments we've gotten seem to be kind of divided between the people who are forward looking and can appreciate that, and those who would say, "What about AM? . . . I like talking to my buddies on AM on 75 and I bought my rig 25 years ago and I hope I never have to buy another one."

Of course, the League, you know, did reject the whole idea, so I don't know. We really haven't scoured through those comments yet. But we were a little disappointed; we hoped we would get more from the amateur community on ways to solve this bandwidth measurement problem. It looked like by and large they've sort of thrown up their hands and said, "It's beyond us," which wasn't probably too good of a result — and frankly I think that we're probably back to "square one" looking for new ideas.

Question: What kind of reaction has the FCC received on the new RACES docket, and do you anticipate any alterations?

John: (Begins commentary with funny anecdote deleted here due to space limitations.) Basically, the amateurs came to us with tales of these very serious abuses that the local governments, the police and fire departments, who are eligible for their own services, were making of RACES. The Commission was just about ready to do away with it completely; that is the Department of Defense thing. We kind of presented the argument of "Let's give it one more chance. Let's take it out of the hands of the local governments. If they've got problems with frequencies and emissions available to them in their services, work those out within the services. Don't try to twist something in amateur radio around the wrong way, and let's try and get it back into the hands of the hams."

I don't have very many checks on that other than that the number of applications coming in has been very small, I understand, and we really don't know whether it is going to be a viable program or whether we should just go ahead and do away with the whole thing. I can't really tell at this point; I think it's too early.

Question: Two questions on the bandwidth docket that a lot of amateurs might be interested in. First of all, what about the future of ASCII, the computer code, and secondly, what about the future of amateur TV on 450? The bandwidth docket would essentially eliminate fast scan amateur TV from 420 to 450 MHz. What is the Commission going to do on both of these?

John: Well, you see, ASCII was one of the driving forces behind this, because in order to authorize it we have to go convince Congress to give us the money to go and buy ASCII machines to put in all of our monitoring stations around the country. You could put this away once and for all; then you come up with a better code and we are still talking bandwidth.

The television on 450: As you know, there has been quite a battle on the East coast with the television repeaters, and it did seem to be a rather localized thing. In order to bring out some discussion on this, and see what in the world do amateurs want to do with this, let's propose that they move on "up the band," where you can point and say they really are doing some development work. For TV on 450, it's awfully hard to make a case that "that's development work" and so forth. On 1215, 1296, it's a different story. I think that amateurs could make some very, very worthwhile contributions there, but there has been a reluctance to go because it's easier to get 450 gear, as you know. And we did note that out here, in this part of the country, that you were using 450 for voice communications very heavily. So we did want to get that question out in the open and give all sides a chance to comment and to raise the issue.

Question: Johnny, I don't know whether you are aware of what has been going on in the field of amateur radio public relations, especially out here, but what do you think of amateurs going to the public and introducing amateur radio to them like on radio, TV, etc?

John: Fantastic! Absolutely fantastic. You know, it used to bother me when I was in the rules branch; I used to keep track, and by golly, every time I checked we were losing an average of 350 licensees a month. 350 a month! It just kept going down and down and down, while all the other services were going up. Now there have been a number of things which have happened.

Of course, a lot of people have now become introduced to the glories of two-way radio by virtue of "that other service." But amateur radio has begun to spring up, and a lot of it has to do with the public relations work you are doing and the work your clubs are doing in the training programs. That really is great.

I have heard Commissioners in the past say that "hams were an elite group" — a closed group — and they really weren't living up to all those purposes in 97.1 and all that. It really warms the cockles of my heart to see this (referring to the new attitude of today's more outgoing amateurs in "going public").

There's more . . . a lot more . . . two cassettes full, but for this month we are plum out of space. We will continue with John's comments next month, along with a few other goodies. In the meantime, I wish to express my sincere gratitude to Jim Davis WB@SQP/6, who "blew into town" at the right time and with the proper recording equipment to make a lot of what you read this month possible; to Bill Orenstein KH6IAF/6, whose exceptional expertise in the field of audio and public address systems made recording the San Fernando Club a snap; and most of all to Mr. John B. Johnston K3BNS, for visiting with us in our town and at our radio clubs and for being the warm and gracious individual he is. If ever you have a chance to attend one of John's presentations or should you get a chance to have him as a guest speaker at your club, jump at the opportunity. You will be glad you did.

It was SRO at the San Fernando Valley ARC for John's program!

John is greeted by Lenore Jensen W6NAZ, ARRL public relations assistant for Southern California and "amateur radio's most charming lady."

CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

Please send all contest information directly to me at the address listed above, preferably at least three months before the date of the scheduled event. In other words, the announcement for an event on May 1, 1977, should hopefully be submitted by February 1, 1977.

TAC CONTEST
Starts: 1800 GMT
December 4
Ends: 1800 GMT
December 5

Entries may be single or multi-operator class. All contacts on 3.5 to 3.6 MHz, CW only. General call is "CQ QMF."

EXCHANGE:

RST/001 and progressive QSO numbers from 001.

SCORING:

Contacts with own country, 1 point; each call area in W/K, UA etc., VE/VO, and VK counts as separate country. Contacts with stations in same continent, 2 points; other continents, 5 points. Contacts with HQ station GW8WJ or GW6AQ count 25 points. Total score is sum of contact points times total number of prefixes worked (same as for WPX).

ENTRIES:

Logs must be sent not later than January 31, 1977 to: Peter Lumb G3IRM, 14 Linton Gardens, Bury Saint Edmunds, Suffolk IP33 2DZ, ENGLAND.

ARRL 160 METER CONTEST
Starts: 2200 GMT Friday
December 4
Ends: 1600 GMT Sunday
December 5

The 7th annual ARRL 160 Meter Contest is open to all amateurs on CW only. Multi-operator work is permitted and scores will be listed separately in the results, but they will not be eligible for certificates.

EXCHANGE:

RST and ARRL section or country.

SCORING:

QSOs with amateurs in an ARRL section count 2 points; QSOs with amateurs not in an ARRL section are worth 5 points. DX to DX QSOs do not count. Multiplier is the total number of ARRL sections (74), VE8, and foreign countries worked.

AWARDS:

Certificates will be awarded for section and non W/VE country high scores. Division high scores will have their section award endorsed with an appropriate seal.

FORMS:

It is suggested that contest forms be obtained from ARRL, 225 Main St., Newington CT 06111. Check sheets are not required but a penalty of 3 additional contacts will be made for each duplicate contact.

These rules were taken from last year's contest. For complete rules, see the November issue of QST.

ARRL 10 METER CONTEST
Starts: 1200 GMT Saturday,
December 11
Ends: 2359 GMT Sunday,
December 12

The contest is open to all amateurs worldwide. All QSOs must take place on 10 meters and OSCAR QSOs are valid. Each station can be worked on phone-to-phone and CW-to-CW, and anyone can work anyone. All CW contacts must be made between 28.0 and 28.5 MHz, unless working through OSCAR. When operating on 10 meters, please avoid the OSCAR downlink frequencies.

CLASSES:

Entries will be classified as either single or multiple operator stations. Multiple transmitter stations are not allowed.

EXCHANGE:

All W/VE stations will send RS(T) and state or province. Others will send RS(T) and consecutive serial number starting with 001. Stations that are not land based will send RS(T) and ITU Region (1, 2 or 3). The District of Columbia is counted as part of Maryland.

SCORING:

Each completed QSO counts 2 points, or 4 points if with a W or K Novice. The multiplier is the sum of the total number of states, Canadian call areas (max. 9), ARRL countries (not US or Canada), and ITU regions from non-land based stations. Final score is the sum of the QSO points times the total multiplier.

AWARDS:

A certificate will be awarded to the highest scoring single operator station in each section, Canadian call area, and foreign country. Region awards for non-land based stations, and awards for multi-operator and Novice stations will be issued if warranted.

FORMS:

It is suggested that contest forms be obtained before the contest from ARRL, 225 Main St., Newington CT 06111; include an SASE. Check sheets are not required but a penalty of 3 additional contacts will be made for each duplicate contact.

These rules were taken from last years contest. For complete rules, see the November issue of QST.

HUNGARIAN DX CONTEST
Starts: 1600 GMT Saturday,
December 11
Ends: 1600 GMT Sunday,
December 12

The contest is sponsored by the Hungarian Radioamateur Society and is open to any licensed radio amateur. All amateur bands from 80 to 10 meters may be used on CW only. General call is "TEST HA" while Hungarian will give "TEST WW." Entries may be in any of the following classes: single op, single band; single op, multi-band; or multi-op, multi-band.

EXCHANGE:

RST and continuous serial number from 001. After their signal report, Hungarian stations will give a two letter code for their location (county) as follows: BA, BP, BE, BN, BO, CS, FE, GY, HA, HE, KO, NO, PE, SA, SO, SZ, TO, VA, VE, ZA.

SCORING:

Each HA QSO counts 1 point. The same station may be worked only once per band. Each different HA county worked counts 1 multiplier point per band. Final score is total QSO points times sum of multiplier points from each band.

ENTRIES:

Logs must be made in usual form with summary sheet and signed declaration. They should be mailed within 6 weeks after the contest to: Radio Amateur League of Budapest, H-1553 Budapest, P.O. Box 2, HUNGARY.

AWARDS:

Certificates to first place station from each country in each class or section. Additional places if warranted.

ARRL STRAIGHT KEY NIGHT
0100-0700 GMT SATURDAY
JANUARY 1

Check *QST* for any changes in the rules!

Basically, rules require the use of a straight key only. Send "SKN" instead of "RST" during QSOs, to help identify contest stations. On 80-40-20 meters, try 060 to 080 kHz up from the bottom edge of the band. On Novice bands, try 10 kHz up from the bottom of the Novice band. After the contest period, send a list of calls of the stations contacted during the contest period, plus your note for the best fist heard. Please mail entries as soon as possible to ARRL, 225 Main Street, Newington CT 06111.

SOWP CHRISTMAS QSO PARTY

The Society of Wireless Pioneers will conduct a membership on-the-air QSO Party on the weekend of December 18 and 19, 1976. The party will cover the full 48-hour GMT period and will be the first "voice" party scheduled by the Society. The purpose of the affair will be to give members an opportunity to meet one another and to pass along their season's greetings, etc. There will be

CALENDAR

Dec 4 - 5	ARRL 160 Meter Contest
Dec 4 - 5	TAC Contest
Dec 11 - 12	ARRL 10 Meter Contest
Dec 11 - 12	Hungarian DX Contest
Jan 1	Straight Key Night (ARRL)
Jan 15 - 16	QRP Winter Contest
Feb 19 - 20	YLRL YL-OM Contest – Phone
Mar 5 - 6	YLRL YL-OM Contest – CW
Mar 26 - 27	CQ Worldwide WPX SSB Contest
Apr 12 - 13	YLRL DX-YL to Stateside YL Contest – CW
Apr 26 - 27	YLRL DX-YL to Stateside YL Contest – Phone

Note: The official dates for the 1977 ARRL contests had not been announced at the time of this writing. Tentative dates should be:

Jan 1 - 2	VHF Sweepstakes
Feb 5 - 6	DX Contest – Phone
Feb 5 - 13	Novice Roundup
Feb 19 - 20	DX Contest – CW
Mar 5 - 6	DX Contest – Phone
Mar 19 - 20	DX Contest – CW

no formal exchange requirements and no need to submit logs.

All members with a phone capability are encouraged to participate. The call will be CQ SOWP. While there will be no certificates awarded, everyone who takes part will be a winner by having an opportunity to renew old friendships, establish new ones and to continue a comaraderie developed over the years.

Suggested frequencies for the affair are 25 kHz (±) 5 kHz up from the low end of the General class phone portion of each amateur band.

BUDAPEST AWARD

This award was originally founded in 1963, but the rules were changed effective January 1st, 1976 as follows:

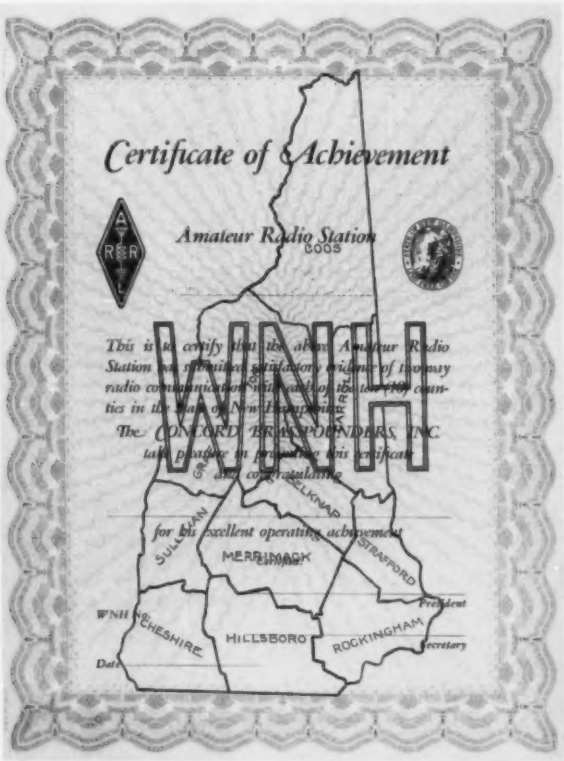
The certificate is issued in one class and may be received only once. There are no endorsements. Contacts are valid after January 1, 1959, but each station may be used only once in your application. Any amateur band and mode may be used including active land or air VHF/UHF repeaters. European stations must contact 75 HA5 or HG5 stations, while DX stations (including US) need only contact 25. On VHF, only 50 different HA/HG5 stations or 5000 kms summarized distance; any contacts made via satellites or via the moon count with 500 kms/QSO value. Send a list of your contacts and 10 IRCs to the Award Manager of BRAL, Dezso Tarcsay HA5HA, H-1553 Budapest, P.O. Box 2, HUNGARY. The award is also available for SWLs on a "heard" basis with the same rules and fee.

BICENTENNIAL WORKED ALL STATES NET AWARD

The Bicentennial Worked All States Net that meets on 3905 kHz nightly at 0500 GMT is now offering its award for working all states during the Bicentennial year. All contacts must be made on the net frequency during net operation or at least within one hour of the beginning or closing of the net. They must be made from the same QTH (or from locations not more than 25 miles apart) and confirmed in writing. Cost of the award is $2.00 and QSLs need not be sent; only an application form verified by another amateur is requested. For an application and complete information contact Gene Densmore AA4WCG, 2125 Cambridge Drive, Tallahassee FL 32304. By the way, the awards will not be numbered or dated other than 1976, so there is no rush or time limit other than making the required contacts during 1976!

WORKED ALL NEW HAMPSHIRE

The Concord Brasspounders, Inc., of Concord, N.H., are again making available to all qualified amateurs their Certificate of Achievement for working and confirming all ten New Hampshire counties. The ten QSL cards or a request for information should be sent to Basil Cutting W1JB, Suncook, N.H. 03275.



RESULTS

RESULTS OF 1976 BERMUDA CONTEST

Top N.A. Stations:

CW		Phone	
K2BT	11,253 pts	W1HFB	37,170 pts
VE1CD	10,668	W4UPJ	21,942
WA2DIG	6,402	K2BT	19,032
WØOUE	6,384	VE1AGH	17,346
W9OHH	5,451	W1DO	14,076

Top U.K. Stations:

CW		Phone	
G3FXB	32,637	G4GI	46,494
G4BUE	22,176	G3VPW	24,420
G4CNY	14,739	GW4BLE	23,904

Island Winners:

CW – G4BKI/VP9 Phone – VP9IB

Oscar Orbits

Oscar 6 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W	Mode
18876	1	0146:12	84.7	BX
18888	2	0046:08	69.7	A
18901	3	0141:04	83.4	B
18913	4	0041:00	68.4	A
18926	5	0135:56	82.2	B
18938	6	0035:52	67.2	A
18951	7	0130:47	80.9	B
18963	8	0030:43	65.9	AX
18976	9	0125:39	79.7	B
18988	10	0025:35	64.7	A
19001	11	0120:31	78.4	B
19013	12	0020:27	63.4	A
19026	13	0115:22	77.1	B
19038	14	0015:18	62.1	A
19051	15	0110:14	75.9	BX
19063	16	0010:10	60.9	A
19076	17	0105:06	74.6	B
19088	18	0005:02	59.6	A
19101	19	0059:57	73.4	B
19114	20	0154:53	87.1	A
19126	21	0054:49	72.1	B
19139	22	0149:45	85.9	AX
19151	23	0049:41	70.9	B
19164	24	0144:36	84.6	A
19176	25	0044:32	69.6	B
19189	26	0139:28	83.4	A
19201	27	0039:24	68.4	B
19214	28	0134:20	82.1	A
19226	29	0034:16	67.1	BX
19239	30	0129:11	80.8	A
19251	31	0029:07	65.8	A

Oscar 7 Orbital Information

Orbit	Date (Dec)	Time (GMT)	Longitude of Eq. Crossing °W
9350	1	0035:16	58.6
9363	2	0129:33	72.2
9375	3	0028:54	57.0
9388	4	0123:11	70.6
9400	5	0022:31	55.4
9413	6	0116:48	69.0
9425	7	0016:08	53.8
9438	8	0110:25	67.4
9450	9	0009:45	52.2
9463	10	0104:02	65.8
9475	11	0003:23	50.6
9488	12	0057:40	64.2
9501	13	0151:57	77.8
9513	14	0051:17	62.6
9526	15	0145:34	76.2
9538	16	0044:54	61.0
9551	17	0139:11	74.6
9563	18	0038:31	59.4
9576	19	0132:48	73.0
9588	20	0032:09	57.8
9601	21	0126:26	71.4
9613	22	0025:46	56.2
9626	23	0120:03	69.8
9638	24	0019:23	54.6
9651	25	0113:40	68.2
9663	26	0013:00	53.0
9676	27	0107:17	66.6
9688	28	0006:38	51.4
9701	29	0100:55	65.0
9713	30	0000:15	49.9
9726	31	0054:32	63.4

Effective 1 October, 1976, all AO-7 mode B orbits which fall on GMT Mondays will be designated as QRP orbits, as was done during mid-June, 1976. The success of the three day QRP test has prompted these extra QRP orbits, and it is hoped that users of the AMSAT-OSCAR 7 mode B transponder will reduce their signals to the recommended *ten watts* effective radiated power during these orbits. The use of lower power is also highly recommended during other AMSAT-OSCAR satellite passes because of the beneficial effect it has on the battery. As AO-7 grows older, its battery is deteriorating, and this deterioration is accelerated by users running higher power than is being recommended by AMSAT (100 Watts effective radiated power). This 100 Watts erp *maximum* is enough power to produce very readable signals from horizon to horizon with a small antenna and the average 144 MHz receiving setup. If mode B users cannot hear their 100 Watt erp signal at all times during a pass of AO-7, they should look at their receiving system and should NOT raise their power in order to hear themselves. With cooperation from all users, the AMSAT-OSCAR 7 communications satellite will provide service for the worldwide radio amateur community for years to come.

LETTERS

FORM A POSSE

WA1LET is on the prowl after the rip-offers. After my friend WA1SGX had his 2 meter rig ripped off his car, I put my thinking cap on and started the wheels turning, and this is what I came up with.

I am a member of the "Fidelity Amateur Radio Club," so I am going to propose a rip-off committee, with each member equipped with an Avalanche transistor oscillator in his rig (commercial manufacturers take note) tuned to an outboard receiver (such as a tunnel diode job) so that in the event of his set being ripped off, he can locate the direction his set is going. After the set has gone beyond the legal limit of the license free transmissions set by the FCC, that is where the club gets in the act, by having a club sponsored sensitive receiver able to tune to all the club members' frequencies, giving a master control to direct the posse of members going after the rip-off artist and with such aid, should be able surround the culprit, giving the guy 3 choices: turn him over to the police, hang him, give back the radio with loot to cover the damage done to the owner.

Remember the old days. It will be like a rustler hunt. Maybe I have been reading too many westerns. I believe that only by action on the part of the hams will we be safe from the easy-picking boys. Every club should form a protective committee. The Avalanche oscillator is the only oscillator (I believe) that can give a tremendous pulse with small power. All the bright boys should get busy and send in to *73* their brain child, or send to me, WA1LET, so that we can all get together and scotch the pilferers. I have not had any trouble myself, but have stuck my neck out in the cause of the hams, e.g., in the dockets that have been an enemy to the hams, even when it did not affect me. I hope that my little gabfest will do a little good.

Cy Lievesley WA1LET
142 Brightman St.
Fall River MA 02720

The wheels turned alright – and made mush.

FAIR WEATHER FRIEND

Congratulations on two major counts: 1) for bringing *73* to what it is and continuing to improve it, and 2) for that editorial in the October '76 issue that I just read. I've read some of your "editorialism" in the past that has (on two occasions) caused me to drop my subscription to *73*.

This one shows class. This one tells it like it is – all the way through – about the uPs and even about the contents of *73 Magazine*. I'm referring (if you hadn't guessed) to the I/O Editorial.

I like *73* because *now*, more than any other time in its history, it is a broader-based electronic experimenter's journal. Keep going, and please keep us informed regarding your upcoming Pers-Comp mag.

I've been hamming for about 10 years, from 80m through 450 MHz, and am just recently gaining a keen interest in computer electronics – especially uPs.

Bob Gromer WA7NMJ
Glendale AZ

Thanks, oh fair weather friend. – Wayne.

FUTURE SHOCK

As I was reading the August issue of *73* (around the fourth of July), the article about the computerized ham station seemed very familiar.

Digging through my vast collection of *73* mags, I found a story in the January, 1967, issue. The story was called, "The QRZ Machine," and at the time was science fiction.

The "machine" was described as being about the size of a portable typewriter, and was able to copy CW.

The 1976 Altair microprocessor is a bit larger and in the example copied RTTY, but that ain't bad in just 9 years.

Where would we be today without science fiction to encourage scientific experimentation and advancement?

Tom Grabowski K3SPY
Baltimore MD

Better off.

ABOVE AND BEYOND

Just a few informal remarks and comments on two of the firms that advertise in *73 Magazine*.

I placed an order with B & F Enterprises in Peabody, Mass., for two speaker enclosures as advertised in *73*. Although they did not advertise crossover networks, I asked them, if possible, to send me two threeway crossovers. The order arrived minus one crossover. A communication followed shortly after saying they were backordering one crossover, as they only had one for the original shipment. I asked them to charge the amount of the purchase to my Bank-Americard. Now they could have charged me for the whole order, but they only charged me for what they had shipped, involving additional paperwork when they shipped the second crossover, which arrived a few days later. Now this showed consideration and fairness with their buying customers. Also, the shipment arrived so promptly that I don't see how they could have checked out my Bank-Americard account before shipment. It is a pleasure to do business with companies that show consideration in their dealings with the buying public.

I also placed an order with Aldelco of Lynbrook, N.Y., for some diodes and other materials. I sent them a postal money order to cover the amount of the purchase, and when the order arrived, there had been an error filling the order as they did not send me some of the diodes that I had ordered, and they sent some that I had not ordered. I sent them a communication stating what I had received and not received and asked them to check my original order. I offered to send the diodes that I had not ordered back to them on arrival of the diodes that I had ordered, to fill my original order. A few days later, the diodes that were missing in the original order arrived with a note of apology and stating that I did not need to return the unordered diodes, but to keep them with their compliments. Now you can't ask for anything more fair than that.

And so, Wayne, thanks for your care in selecting advertising firms that are reliable and considerate to advertise in *73*. It is a pleasure to us readers of *73* to do business with that type of firm.

Continued success to you and your staff.

J. Wm. Anderson W6QV
Sunland CA

THE REVOLUTION

Your computer articles have brought me up-to-date after being out of the data processing business for over four years. During this time, I am amazed at the microcomputer revolution, in terms of the available processing power for such a small cost. As a former programmer and computer salesman, perhaps you would benefit from some of my reflections on the current state of the art – sort of like the comments emanating from your "Ancient Aviator."

My first reaction to the microcomputer revolution is simply that very few people even begin to appreciate the problem-solving horsepower possible with a microcomputer. Back in the 1960s I sold small scale business computer systems (for a $100,000 plus purchase price) that were roughly comparable in processing power with the new 6800s and 8080s which are available for less than $10,000 for a disk system. In view of this, it appears that the public must be "educated" in terms of how a microcomputer can be used as a tremendous extension of the mind to handle both home and business applications. To put it another way, less emphasis should be placed on silly games and more thought should be directed towards the way to put a microcomputer to work in the household, hobby and business world.

My second reaction: With the availability of low cost computing, there is a need for good self-teaching programmed instruction manuals and teaching aids. It seems that, at this point, we have low cost effective hardware with a scarcity of materials capable of quickly acquainting the uninitiated in their use. If this market is to grow, this problem must be solved with self-teaching applications and programming manuals, as well as manuals that will show how this equipment can be used in solving the day-to-day problems for which it is so well suited.

My final reaction applies to the question of how to best communicate current knowledge available to other amateur radio operators like myself. In this respect, it seems that we need to organize a hobby computer net that will meet regularly to disseminate useful information. If you know of such a net, please let me know. Also, I would appreciate having the names and addresses of any hobby computer user groups which would be willing to share their knowledge with us mid-westerners who are just beginning to learn about this west coast developed technology.

Robert E. Bunn WA0LKE
Bunn Oil and Supply Co.
508 Porter Wagoner Blvd.
West Plains MO 65775

If you get netted let us know. Re self-teaching, that's what reading 73 *I/O articles and* Kilobyte *is all about.*

THE ELECTRONIC MENSA?

I've just read the article by Robert Fields in the September *73*, and fault it only insofar as it fell short in its castigation of the God Syndrome rampant in amateur ranks.

First, I'm not a CBer (not recently – when CB was young, and legality was in vogue, I had a license, but it has long since gone west). Nor am I a ham. My familiarity with both code and theory is adequate to allow my getting a General ticket tomorrow if so desired, but as of this writing I have seen no facet of ham radio sufficiently challenging that I should waste time so doing.

Further, inasmuch as the majority

of hams of my acquaintance are pompous, stuffed-shirt elitists with delusions of grandeur, I find no incentive in joining up just for the company. And, it is this insufferable arrogance that is turning off would-be hams in droves.

Also, let's forget that bull about ham radio being anything more than a medium for rag chewing. The experimental phase went out with the 6L6, and modern R/D labs backed by corporate financing are the innovators now, not the basement black-box builder. The day of the lone inventor is just about kaput. Granted, hams are using state-of-the-art technology — computers, TV, etc. — but none of it came from ham circles.

If you ham types want to multiply your folds, get off your goddamn pedestals, dismount from your shining white steeds, and mingle with the masses. Anyone with half a wit who's had a taste of modern-day CB would welcome ham radio if, in it, he could find the camaraderie that CB, with all its failings, offers on and off the air. It is sad that in most cases he encounters the snobbery of ham radio's electronic Mensa, and, as Mr. Fields says, trots off to unload his wallet on a Pentax instead of an ICOM or a Heathkit.

K. T. Derek
Pittsfield MA

Well, OM, there is some truth to what you say ... that part about CBers being friendly. Other than that it appears to me that you are a sad victim of what is called projection in psychological circles. If you do decide to give hamming a try, I think you may find, as the rest of us have, that hams are about as friendly a gang as you could ask for ... they help each other ... love to talk ... and are going way out of their way all over the country to help CBers get their ham tickets. Sure there are a few curmudgeons ... they are there in CB too, but that doesn't change the average ham from being a great guy. If you'd read much of 73 you would know that hams are in the forefront of many new technical developments ... such as RTTY, SSTV, and even computer applications. As one of the founders of American Mensa (1960) and a member ever since, I have attended meetings in many cities and seldom have I run up against the snobbery you seem to have found. If that were the case, Mensa would have disappeared long ago. I wonder what other readers think about hams being snobs? — Wayne.

SATISFIED

I am prompted to write this both in praise and disgust.

The praise goes to the Delaware Emergency Net for their damn good work during the Belle hurricane: Elmer W3YAH, Vince W3SEG and all the others who pitched in and did their very best.

Elmer lives on Lewes Island, and when the island was being evacuated, he said "As long as I have power, I'll be on the air, and when I lose it, I'll go too." That is ham radio above and beyond.

The disgust is with the selfish slobs who sat down right on freq and, after repeated reminding, called CQ and finished a QSO, and also with the ones who opened up with an unmodulated carrier for extended periods.

Well, I said it, and I'm satisfied. Thanks for listening.

Bill Simms WA2JNV
Toms River NJ

Jamming is a growing facet of amateur radio.

FEEDBACK

Please note a correction to my article, "ASCII/Baudot Converter for Your TVT," which began on page 150 of the November, 1976, issue. In Table 2(b), $5/A_1$ should be a one instead of a zero.

Jeff Roloff
Champaign IL

Let's watch that stuff, Roloff.

COMMON INTERESTS

Keep up the good work on *73*; it is appreciated. I am not a microcomputer nut (yet), but the articles are interesting as I use an IBM system 360/370 in my work. The ads for Mother Bell are an eye-opener, especially for those of us who work for AT&T. It's nice to see the two communications interests (Bell and ham) cooperating for a change. Now if the FCC will just let us legalize tariffs for phone/autopatch systems!

Arv Evans K7HKL
Salt Lake City UT

GOTTEN

A short comment on your I/O Report in the August issue of *73 Mag*: I think you are really missing the boat by excluding the DEC LSI-11 and PDP-11/PDP-8 programs from your section. Various computer clubs around the nation have acquired OEM status with DEC to buy LSI-11s in quantities and pass the low prices on to members. One club in California has helped over 500 hackers to get LSI-11s. When I was working at DEC, the orders were flooding in. And why not, for the price of an Altair or IMSAI look what you can get from DEC ... the LSI-11 is about $650, an interface is another $100 or $150, and all you need is a power supply and terminal. No need for a monitor program with the built-in ODT debugging. And it comes with 4K x 16 RAM standard, with power fail and line clock! They also produce a PDP-8/A, a single board PDP-8 that would also be in the price range of the hobbyist. On top of all this, DEC has been making MPS boards for several years that also may be of interest to hackers.

Bob Baker WB2GFE
Atco NJ

I think you got me on that one, Bob. I wasn't thinking of the LSI-11 when I singled out the DEC PDP-11. There is certainly going to be hobbyist (and other) software generated for the LSI-11 which might be of interest to I/O readers. If any comes my way I'll give it every consideration. And with regard to the PDP-8 ... I hope we see software for it coming into the hobby community both from simulators being written (for an 8080) and/or from the popularity of the Intersil 6100 getting a boost. — John.

AN I/O RECORD

In response to one of your ads, I recently purchased the Godbout Software Board. First, I would like to commend Godbout for their excellent service and their fine product. I received my order within five days after the order was placed — a record for computer-related items.

I experienced a few problems in interpreting the literature. I left my number with Godbout and later that day Bill Godbout returned my call — from California to Chattanooga — and we soon had the problems resolved. The Software Board worked the first time I plugged it in the Imsai computer.

To operate this board, one just "examines" location F000 in hex or 360,000 in octal and then hits Run. Thereafter one enters programs using the Intel 8080 mnemonics.

73 Magazine seems to have a policy of accepting ads from only reputable dealers who won't rip off the ham. For those hams considering entering "computronics," you would do well to stay with such firms as Godbout, Hal Communications and those who advertise in *73*. You haven't seen any Trigger Electronics ads lately, have you?

Nenad S. Downing WB4SLO
Chattanooga TN

Trigger ... hmmm, wasn't he a QST *advertiser?*

GONE FISHING

I have used my back issue ham literature to "bait" CB operators. To date can count one total convert and several "nibbles." Photo taken at my portable QTH.

Hal Empie WA7ZYD
Duncan AZ

INACTIVE BROTHERS

This is a CQ to all hams who are

heart pacemaker wearers! Numerous letters to the ham journals indicate a growing need for information about EMI (electromagnetic interference), especially as it relates to ham operating! Pacemaker wearers generally do not have access to reports of EMI susceptibility tests made by military and/or federally sponsored (FDA/BRH) testing programs. As a result, the lack of relevant information leads to confusing, and often erroneous, "advice" from well-meaning but ill-advised individuals.

As a pacemaker wearer since April 1975, and a ham since 1924, I have been compiling interference data in an effort to (1) know my own operating limitations, if any, and (2) to help any other hams with pacemakers who are staying off the air because of fear of pacemaker failure caused by radiation from their rigs.

Will any reader who wears a pacemaker write me and describe any experience which seemed to have been EMI related? For convenience, and to elicit the maximum information, I have prepared a questionnaire which is available for an SASE. This is a worthwhile project, but many answers are needed. For a little bit of your time and a postage stamp, you could get an otherwise inactive brother ham back on the air! QRU?

W. R. (Bill) Schoppe
481 89 Ave. N.
St. Petersburg FL 33702

POINT

In answer to Dave Powell WA4BRI's question in the Letters column of October "Why build in an error?" with reference to my "Instant Counter Calibration" article in the August issue of *73*: There is no error from a practical standpoint!

I won't argue the position that 15,734.265 Hz is the theoretical color horizontal sync rate. In practice, however, 15,734.26374 Hz won't be found any more often than 15,734.265 Hz for the simple reason that the idea behind using a rubidium standard in broadcasting is not so much absolute accuracy, as it is long-term stability. The broadcaster isn't as interested in the absolute frequency (as long as it is well within FCC tolerances) as he is in phasing his local and/or remote equipment to one *stable* standard. This circumstance, however, doesn't make using the horizontal sync signal any less valuable for the radio amateur because it is the most accurate signal available to the average ham, plus it is traceable to NBS through the published offsets.

Additionally, as was mentioned in my article, unless your counter is phase locked to the incoming signal, there will be a ±1 digit ambiguity. My Heath IB-1103 would interpolate Mr. Powell's figure of 15,734.26374 Hz as 15,734.264 Hz, and the least significant digit ambiguity could make this either 15,734.263 Hz or 15,734.265 Hz. To compound the dilemma, the guaranteed one second stability of the Heath counter is .5 ppm which in my case does indeed make the .08 ppm *error* WA4BRI refers to seem insignificant.

My caution with regard to making sure that you are tuned to a network colorcast is aimed mostly at some locally originated CATV (cable) system programs and newly formed low-budget broadcast stations who may not be referenced to a rubidium source. I would still stand behind that statement. The caution regarding "mini-cam" units also stands, if they are in the field and feeding back *live* video via microwave as the statement in my article implies. In this case, they are almost certainly not rubidium locked!

Incidentally, and in closing, I couldn't help but notice the piece in *QST*'s "Hints and Kinks" column for August, 1976 (which arrives *much* later than *73*'s August issue) recommending the same procedure that I cautioned AGAINST using, i.e., connecting directly to the TV receiver circuitry with the counter. I sincerely hope that no one falls victim to serious damage by using the *QST* approach (quite a "kink").

David F. Miller K9POX
Niles IL

Picky, picky.

COUNTER POINT

The letter by Dave Powell WA4BRI in the October letters regarding the article "Instant Counter Calibration" by David F. Miller K9POX has introduced more errors than it has corrected!

The television networks employ far more precision in frequency generation than required by the FCC rules. The signal source as noted by Miller is a rubidium atomic oscillator for NBC and CBS and a cesium atomic oscillator for ABC. These sources synthesize 5 MHz. The color subcarrier is developed by multiplying 5 MHz by 63/88, producing the figure quoted by Miller, 3.5795454.

Next, take this number, multiply it by 2 and divide by 455. Presto, you have Miller's 15.734266.

In the future, it might be helpful to submit critical letters to the original author for comment before publication.

The references listed below contain more information on using color TV signals for calibration.

1. Davis, D. D., "How To Use The Television Color Signal For Calibrating A Crystal Oscillator," National Bureau of Standards, November 1974.
2. . . ., "Daily Television Frequency Transfer Measurements," Services Bulletin, National Bureau of Standards, Monthly (free).
3. Davis, Dick D., "Calibrating Crystal Oscillators With TV Color-Reference Signals," *Electronics*, Vol. 48, No. 6, (March 20, 1975), 107-112.
4. Robbins, Michael S., "Calibrating Frequency With Your TV," *Radio-Electronics*, Vol. 47, No. 9, (September 1976), 74-76.

Michael S. Robbins K6QAH
Los Angeles CA

You're quite a bookworm, Mike.

INFLATION, ETC.

I would appreciate it if you would publish the following in *73* as soon as possible:

"REPEATERMEISTER"
UPDATE

All negatives requested after 15 August, 1976, will incorporate the changes described below.

CW ID

ID initiate input IC, 7432, now has four initiate inputs -- pins 1, 2, 4 and 5. Use 330 Ohm resistors to ground. This makes operation more convenient and less wasteful of gates.

Clock oscillator IC, 7400. Use a 5k trimpot with a 1k ¼ W resistor in parallel. This improves the operation of the oscillator and also limits the sending speed from 5 wpm to about 25 wpm.

TX hold transistor, Q1, 2N708. Any general purpose NPN switching transistor may be substituted. Be certain that IC will not be exceeded by the keying circuitry in the transmitter. Also, foil pattern has been modified for the following change: At the collector of Q1, install two germanium diodes with the band towards the collector of Q1 (1N34 or 1N60). Jumper one diode to pins 4 and 6 of IC2a. This gives a 5 second tail after each ID. Jumper the other diode to the collector of Q4 on the MLB, which is the PTT output.

MLB

Pads have been added to the 7413 Schmitt Trigger for the input-output connections.

Replace the jumper at IC2 from pin 4 to the collector of Q2 with a germanium diode, band towards Q2. A pad has been added at pin 6 for the jumper from the CW ID described above.

Receiver off timer, IC3, 555. On some negatives pins 6 and 7 are not connected. Solder bridge these pins for correct operation.

Same goes for the transistors on the MLB. Any NPN general purpose switching transistor may be used. Be certain that Q4 can sink the required current from the keying circuitry that follows.

The 100 Ohm resistor on the collector of Q3 may be increased to 150 Ohms.

The resistor value in the schematic, 2.2 megohms, at pins 6 and 7 of IC3, 555, is the correct value, although 1.5 meg is shown in the parts layout.

Pads have been added for the 1.8k resistor at the base of Q5, the autopatch control transistor.

Due to increased costs of materials (mainly film), after November 1st negatives will be $.75 each. Preprogrammed 8223 IC available. Your chip and $4.00 plus message desired; or $7.00 and message desired, I supply IC. Etched and drilled boards on G-10 glass epoxy also available. $7.00 each or both for $12.00 (limited supply). Approximately two weeks delivery.

Geoffry W. Kufchak WA1UFE
15 Fourth Ave.
Westover AFB MA 01022

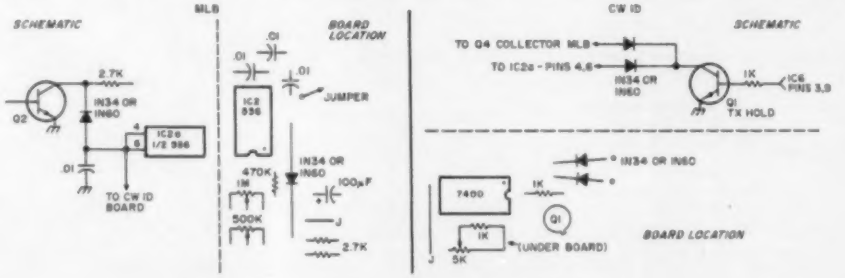
OBSESSED

I read those gripes in your mail about small computers in your mag. I hope you don't give in. A couple of years ago when I saw articles about them in the popular mags, I brushed over them thinking they were just toys -- like imitations of the *real thing* (which of course no one but a genius could understand).

This is my tenth month of intensive concentration on them. I became involved because I wanted to translate commodity market prices coming in on a telegraph line into price display and possibly charts so I could trade them without losing so much money.

I'm building a home brew affair with Altair compatibility.

Knowing I would need a display, the "Sol" terminal seemed like just



the thing (Processor Technology). Maybe I could use it to translate the special hex code into ASCII as well, so I ordered a circuit board and spent a week locating and sending for all the other stuff only to find out they are redesigning it and I won't get the board 'til September. It's a good thing I haven't started on the CPU board, because *now* I'm going to *have* to get a Zilogue board instead.

In other words, the information explosion has gotten me. Not only do I have a busted bladder, but bleary eyes from reading all that fine print in spec manuals trying to learn enough so the thing will be sure to work when I get it finished. (Could it ever be?)

You guessed it. I'm obsessed with computers, day and night. Even though my puttering goes back to the oatmeal box tuning coil and the 01A tube, nothing has bitten me quite as badly as the computer bug. So keep up the good work — no construction articles with lines running off the page to something or other. If we don't actually see it hooked to something, how can we be *sure* where it goes?

Out here, we appreciate what you're doing, so keep up the good work.

"Brad" Bradford
East Braintree MA

I get into enough trouble without your encouragement. — Wayne.

OFF BASE

We've been licensed for over 56 years. Were on a little before that, before licensing was required by Herb Hoover, who first took charge. Came on first on 300 meters with spark, then 200 meters, then 1750-2000, then 1800 to 2000 and the rest of the bands.

When *73* first came into business, we were one of your first subscribers, and also wrote you a few articles. Boy, how the years do fly!

Quit *QST* years ago — no longer a *real* ham organ as it was when "Hiram" ran it (and later his immediate successors). Present boys are more for business interests than hams. Hams play 2nd fiddle! Buy *QST* now and then to see if it's any better, but no! HI!

Wrote an article a couple of years ago pointing up how a few manufacturers such as Millen will sell direct to hams to promote building (I'm a builder — always was). In it I criticized those manufacturers who make components and also equipment for making components hard for hams to get — so as to force purchase of equipment. I compliment Millen and others who either sell direct to hams or *promote* components to distributors (instead of blocking distributors), etc., etc.

QST refused to print it. It would have helped hams who build, but *QST* was more concerned about their "big boy" advertisers!

Just thought you might like the above facts for what they are worth.

Jim Grindle W9QS
Chesterton IN

Jim, I wouldn't have published your letter either, and not for fear of any advertisers . . . but because I think you are off base. Distributors got out of the parts business because it was not profitable . . . pure and simple. One result of the incentive licensing (proposed by ARRL/QST in 1963) was that not only did ham growth stop and over 75% of the sale of equipment stop for several years, but hams stopped building, too. It got so Lafayette was the only place you could buy parts as several hundred distributors gave up the ghost. Parts houses are back in force now, but are more specialized . . . Godbout, James, SD Sales, Optoelectronics, Bullet, Verada, Poly Paks, Meshna, Tri-Tek, Whitehouse . . . etc. — Wayne.

THE NOVICE CLASS

I subscribe to both *73* and *QST*, but find your magazine to be the best. Certainly I tend to agree with your political outlook as regards amateur radio more often than I do that of the ARRL.

I am a new amateur, but with a long time interest in the hobby. I tried once before about twelve or fourteen years ago to get a license but was unsuccessful. Now I am the proud holder of a new Novice ticket. This leads me to write the following comment about the Novice class.

One of the reasons that I didn't get the license earlier was that I wished to skip the restrictions placed upon the Novice (and CW) and go directly to the General class, but I was a fairly young and inexperienced child at the time and found everything involved just too frustrating and just let the whole thing drop. If I had gone for the Novice ticket, I could have been on the air and gathering experience, instead of being just more and more turned off by the whole thing.

In the Novice class that I attended I found the same thing to be still true. There was one small boy (how come there aren't more small girls? — but that's another problem) who was having a lot of difficulty. He could have been coached and hand-held through a Novice exam, but I am not so sure that he could have been coached enough to pass a more advanced test. I know that there are very young children who manage to pass Extra exams, but I am concerned with the *average* child. For these children the Novice license is ideal, and I think that it should be retained. I am glad to see that the FCC is making steps in the direction of a renewable license in this class.

I took the Novice test because I wanted to be able to operate while I was studying for the General (Advanced really, but I am trying not to give into *hubris*). I would have taken the Technician, but six months ago there were no high frequency privileges for this class. For older, more advanced individuals, this seems to me to be a better entry class.

There are many problems with getting started in amateur radio, and if we want the hobby to grow we should systematically consider them along with possible solutions. I just wanted to air my thoughts on this one aspect of the problem. I am a professional educator and the learning aspects of amateur radio are thus close to my heart.

John Thomas Berry WN6NZW
Pasadena CA

OFF TRACK

Shortly after assembling my SB-401 two years ago, the transmit-receive relay began to stick, especially after lengthy transmissions or extended tune-up periods. Measuring voltage across RL2 revealed that voltage was indeed dropping, yet the relay just wouldn't quit. Popping the function switch to spot would restore normal operation, and running the companion SB-200 seemed to reduce the problem almost completely.

It wasn't until recently that the sticky relay problem finally prompted some real action. A local Novice bought the SB-401 and, after operating CW for a while, aggravated the situation so that the relay wouldn't respond to the old spot trick. Replace the relay was one answer, since it seemed like the problem could be residual magnetism.

A call to Heath showed how far off the track we were. Dave Poplewski knew immediately what we were up against . . . and answered that there were two ways to solve the problem (an expensive one and a cheap one). Needless to say, we were most interested in the cheap way out. Dave explained that the problem was soft finals — finals that were not soft enough to affect output, but soft enough to allow screen grid leakage through RL1 back to RL2. The best cure, Dave advised, was to ground lug 7 of RL1. That way screen grid leakage can't reach the transmit-receive relay, RL2. The expensive cure? Replace the finals.

Warren Elly WA1GUD/1
Bennington NH

One other cure — learn how to tune your rig.

I/O RIP-OFF

Please publish the following letter in an attempt to recover a stolen computer system from my home on or about the fourth of September of this year.

The equipment taken is listed as follows: (1) 1 Altair 8800 consisting of (a) 1 CPU card, (b) 6 88-4MCD dynamic memory cards, (c) 1 16K static memory card (Mikra-D), (d) 1 88-DCDD disc controller card set (2 cards), (e) 2 88-disc floppy disc drives, (f) 1 88-PMC PROM memory card with PROM, (g) 1 88-ACR cassette interface, (h) 1 88-2SIO serial interface with both ports; (2) 1 HP-65 programmable calculator; (3) camera equipment consisting of (a) 1 Honeywell Pentax Spotmatic II with 1.4 lens, (b) 1 Vivatar 85-205 mm autozoom lens, (c) 1 Honeywell 450 autostrobonar flash.

If anyone reading this letter has a reason to believe he has been offered any of this equipment or thinks he has seen this equipment, please contact your local police authorities or contact me at the following address.

John W. Swain
3687 N. East County Line Road
Indianapolis IN 46236
(317)-894-7271

You waited too long to write your house security program.

CATCHING ON

Your magazine and the articles in it have shown me the close relationship hams have with each other and this is what encouraged me more than anything else to work for my amateur ticket. Some of your articles are still a little deep for my shallow mind, but I'm catching on. Keep up the good work — you have a fine magazine.

Bill Raney WN5TGS
Laredo TX

THE GENERAL GOOD

This hint has saved me a lot of bother, and you might find it worth passing on for the general good:

You have finally decided that the antenna halliards must be replaced before they fall apart, and you have a length of fine new rope for the job. But how to get it through that pulley at the top of the tower? The sheave won't pass a knot, or even a splice. So you climb the tower, or lower it to the ground. Neither one!

Take a four inch length of coax, RG 58/U for small rope, or RG 8/U for thicker stuff. Cut off and discard all but the braid. Insert one end of the old rope into one end of the braid, and an end of the new one into the other. Pull taut, and the harder you pull, the firmer the grip of the braid on the rope ends. It may be necessary to wrap a few turns of thread around the leading end of the braid to control fraying. Pull down the free end of the old rope and let the new one follow it through the sheave and back to

Continued on page 25

New Products

EICO DLP-6

If you've been working with digital logic circuits, you've probably already discovered that there's no really simple way to debug them. At first glance, this may seem surprising. One of the nice features of logic is that you don't generally know or care what the exact voltage level at a test point is . . . only if it's high or low, a logic 1 or 0. As a matter of fact, a cheap VOM is quite adequate for static logic, and a dc scope is even better. Since the voltages aren't important, a circuit using an LED which lights for a 1, and is unlit for a zero, is great, and for $20 to $200, depending on your tastes and budget, you can buy one of several clip-on probes that will display the logic level on each pin of a 14- or 16-pin DIP. The better ones don't even need power -- they locate and draw from the supply pins of the IC itself.

The problem is that most of the interesting logic circuits aren't static -- there are all kinds of pulses flying around, and it's usually these pulses that are the important factors. Worse yet, they don't always come at regular time intervals, so you can't sync them in on an inexpensive, repetitive-trace scope. Even if you could, you may not be able to see them. TTL logic can respond to pulses that can't be seen on any but the fastest scopes. One trick I've seen is to use a triggered sweep scope, with the threshold set so it normally doesn't sweep. When you get a sweep, you still can't see the pulse, but you know something pulled the trigger (of course, it could have been your wife's hair dryer). Aside from the obvious overkill of using a $3000 scope to check out a handful of 20¢ gates, this method is not too satisfactory. The setting of the threshold is tricky, especially if there are other pulses around, and you still never see that pulse.

Straight LED indicators are no better. While the response time of an LED is very fast, that of your eyeball isn't. As it turns out, the human eye can see surprisingly short pulses of light, under the right conditions, but it has a long retention time. This means that in a darkroom, you *may* see that LED flash on; you'll never see a lit LED flash *off*.

It looks like what this country needs is a good $20 logic probe that can see pulses of either polarity, as well as static levels, and display the situation to you in a way that can't be misunderstood. The Eico DLP-6 is an LED probe that fills the bill. The key feature is a pulse-stretcher that detects positive- or negative-going pulses as short as 50 ns, and gives you about a half-second flash on a pulse LED. In this respect it's similar to Ted Lincoln's circuit (*73*, Aug. 76, pg. 106). It also has LEDs for both high and low static levels, which permit a feature I haven't seen before -- it can tell the difference between an active high or low, and an open circuit. This can be really useful. As a final touch, the three LEDs are different colors (red, green and yellow), so unless you're color blind, it's pretty hard not to get the message.

The DLP-6 comes in a bubble pack, complete with a small plastic carrying case. All parts mount on a narrow PC board, which slips inside the body of the probe. Assembly is quite straightforward and takes about an hour. The instructions are no Heathkit manual, and there's one error in one of the figures, but in general everything went together as intended. Eico says to use the green LED for the "high" indicator, and red for "low." This seemed backwards to me, so I reversed them. The LEDs seem to be interchangeable, so use your own color scheme. If you make up your mind *before* soldering them in, you may not burn them up removing them as I did! (LEDs are more sensitive to heat than ICs, and these have to mount absolutely flush with the PC board or you won't be able to get it into the probe body. A power cord comes out the back of the probe, and is terminated with alligator clips. Yes, Virginia, the probe needs external power. You didn't think you were going to draw power from the chip with just the probe tip, did you?)

In operation, just connect the two alligator clips to any source of five volt power and ground, and you're ready to start probing. The three-color system is very easy to read, and after a little practice you can get quite a bit of information from those three lights.

Recently, I had occasion to use the DLP-6 to find a bug in my TVT-II. I had been trying for two days to find a missing pulse, before it slowly dawned on me that the pulse was so short I wouldn't be able to see it on my scope even when I "found" it. Using the DLP-6, it took about fifteen minutes to find a NAND gate with positive pulses in on all inputs, but no negative pulse out. Aha!

As a matter of background, the circuit used in the DLP-6 originally appeared in *Popular Electronics* (Richard P. May, March '74, pp. 33-35), along with a PC layout, so apparently both are in the public domain. Buy it or build it, but try it; you'll like it!

Dr. Jack W. Crenshaw
1409 Blevins Gap Rd.
Huntsville AL

THE KLM MULTI-2700 ALL MODE TRANSCEIVER

With interest in OSCAR mounting, and SSB activity up on 2 meter FM, it was inevitable that someone was going to come up with a do anything/everything transceiver. Now, KLM has. It's the new Multi-2700 . . . with OSCAR Mode A, upper and lower sideband, WBFM, NBFM, AM and CW all stuffed into one 28 lb. package.

When KLM introduced the Multi-2000 some years ago, it was in a class by itself. Then came Kenwood's TS-700A and the Yaesu FT-221, and the VHF sideband boom was on (commercially speaking). But no one offered the best of both worlds . . . it was either a synthesizer or VFO . . . no combinations. OSCAR work still required a separate receiver and transmitter, but SSB activity on the satellite sure came up.

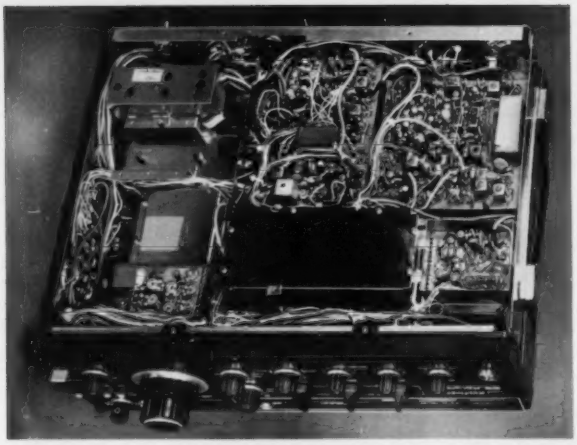
The next step was to put it all in one package. With Mode A in mind, KLM's idea was to synchronize 29 MHz receive with 145 MHz transmit, while maintaining a constant 116.45 MHz difference between them. Using the synthesizer and VFO you can work through the satellite or monitor beacon signals at the flick of a switch. Because the Multi is a transceiver, however, the big difference between normal OSCAR operation and using the 2700 is that you can't monitor your relayed signals from the satellite. One then has to rely on the beacon signal (received separately on the synthesizer). As long as you can hear the beacon, you can work the satellite. KLM has left room for Mode B work, with a 450 MHz converter coming to fit into internal terminals. (50 MHz converters are also planned.)

The Multi-2700, in a word, is loaded. There's an 8 pole SSB filter, two FM filters, VXO and RIT, LED readout on the synthesizer, audio speech compression, ac/dc power supply, separate output and deviation meters and VOX. The VFO setup features a 5 to 1 tuning ratio, with the inside knob going 20 kHz per revolution and the outer knob going 100 kHz.

All that costs money, of course, and the Multi's price tag reflects it. But at $799.95 KLM's newest is not out of the price class for all-mode VHF gear. At that rate the OSCAR capability, hear your own signals through the satellite or not, is a bonus.

Operating the 2700 is pretty simple, and with only a vertical both SSB stations and repeaters could be worked quite adequately. Working OSCAR, however, takes a bit more practice with the VFO and synthesizer. Availability may be an initial problem; as we go to press only 25 units have reached the states, but a KLM spokesman says production should be up substantially by the time you read this.

A clean layout -- with VOX, AGC and gain controls accessible through top port.



The "guts" view -- note 29 MHz receiver, upper left, and space for plug-in 450 MHz unit below.

NEW 1977 RADIO SHACK CATALOG No. 276 NOW AVAILABLE

Radio Shack's new 1977 Electronics Catalog, featuring its exclusive line of products for home entertainment, hobbyists, CBers and experimenters, is now available from Radio Shack stores and dealers, nationwide.

The all-new 164-page catalog includes 100 full-color pages describing the company's complete line of products. Prices in the new catalog, which marks Radio Shack's 56th year in business, are reported to be, on the average, within 1% of the company's average 1975 prices.

Among the new items introduced in the catalog are: eight new stereo FM/AM receivers, led off by the Realistic STA-2000 75 Watt per channel receiver, the Optimus T-100 Tower speaker system, the new LAB-300 turntable and several new stereo tape cassette recorders.

Radio Shack is also introducing an all-new line of pocket calculators ranging in price from $10.95 for a 5-function model, to $39.95 for a scientific slide-rule calculator.

Other items featured in the catalog include: Realistic-brand CB two-way radios, automotive tape players, portable radios and scanning monitors, Archer antennas, Micronta test instruments and ArcherKit and Science Fair electronic and hobby kits.

In addition, the new catalog lists hundreds of specialized electronics items, parts and accessories, tools, tubes, semiconductors, wire and cable, home security products, intercoms, microphones, timers, batteries and a complete library of Radio Shack's own books on electronics and related subjects.

The catalog also includes bonus coupons good for a 50% savings on the company's own Supertape and Realistic brands of tape, and a coupon worth $1.00 on the purchase of their $1.25 book, *All About CB Two-Way Radio.*

In announcing the new catalog, Radio Shack president Lewis Kornfeld stated: "That great old American institution, the Radio Shack catalog, has just been published again, entirely revised, available in all our stores, and still free! Free to you. To us it represents an investment over $3 million.

"The total printing comes to 2,132,000,000 pages," Kornfeld continued. "Stretched end to end: 1,777,777,777 linear feet or 336,700 miles, or 13.525347 times around the world at the equator. The new 1977 edition consumed 3787.5 tons of paper and 1,222,000 pounds of ink. These statistics are revealed to discourage our competition. And to give cheer to America's postmen who don't have to deliver the catalog since none are mailed -- you'll have to get your copy at one of our stores."

NEW VIZ FREQUENCY COUNTER USES PRECISE CRYSTAL-CONTROLLED TIMEBASE FOR EXCEPTIONAL ACCURACY

VIZ Manufacturing Company has introduced a frequency counter to its growing line of test instruments. The WD-752A counter is designed for making frequency measurements between 10 Hz and 60 MHz in audio, video, CB, ham radio and other communications equipment.

A unique feature of the counter is its 1 kHz audible sidetone with separate on-off volume control. The 1 kHz tone is valuable in modulating single sideband transceivers for carrier frequency measurement. The counter has a selectable input sensitivity of either 10 or 100 mV; the lower sensitivity is valuable when considerable noise is present with the signal.

The counter uses a carefully selected 10.000 MHz crystal to create an extremely accurate timebase, ensuring the accuracy of the 10, 100 and 1000 millisecond gate signals and logic control. The measuring circuit is composed of a six-state IC counter which feeds into a very bright readout made up of six 0.3" seven-segment LEDs. The frequency, decimal point, and range (either MHz or kHz) are all displayed automatically. A signal lamp indicates when the signal is sufficiently strong to be counted and indicates when the higher sensitivity input is required. An overflow lamp indicates a signal that exceeds 1 MHz when using the 1 second fixed gate.

The BNC input is compatible with most standard broadband oscilloscope probes. When making measurements of transmitter or transceiver AM frequencies, the counter is positioned near the transmitter and a one meter cable attached to the input serves as a pickup antenna. The counter can also be attached directly to a transmitter or transceiver with a directional coupler and dummy load.

The counter operates on 115 V ± 10 V, 50/60 Hz. The unit is extremely compact, measuring only 2-5/8" x 5-3/4" x 9-1/4", and weighs only 4 lbs. The dealer optional price is $255.00.

Further information on the WD-752A frequency counter is available from Bob Liska, VIZ Test Instruments Group. *VIZ Mfg. Co., 335 E. Price St., Philadelphia PA 19144, (215)-844-2626.*

NATIONAL'S NEW VOLTAGE REGULATOR HANDBOOK

It would be difficult to find a handier guide to voltage regulators than National Semiconductor's latest release. The handbook is chock-full of great circuits, theory and seemingly endless specs on not only National's line, but comparison data on the competition as well.

It truly is a handbook, since the opening pages cover power supply design basics, transformer specifications, rectifier circuits, filtering and load effects. But that's not all. Heat flow and thermal resistance theory get their due along with heat sink design and applications.

At $3 a shot (California residents add 6% sales tax) the *National Voltage Regulator Handbook* is a heck of a value. Send your check to National Semiconductor Corp., Marketing Services Department, 2900 Semiconductor Drive, Santa Clara CA 95051.

Warren Elly WA1GUD/1
Bennington NH

THE SENCORE F-14 FIELD EFFECT METER

Like most hams interested in construction and troubleshooting, I have become accustomed to having two types of meters to fill my needs. A 20k Ohm VOM was used for portability, general testing and, most essentially, for current measurements. A VTVM was also a must for high impedance voltages, and with an accessory probe for rf measurements. Redundancy was unavoidable since both types of meters offer duplicate capabilities in some respects, while each possesses its own uniquely desirable features.

A recent drive to improve the station test facilities, and a searching review of the latest products, led to the acquisition of the Sencore F-14 Field Effect Meter, which succeeds in obsoleting both of my original meters.

Of particular interest to hams is the fact that the F-14 packs all the desirable features of a VOM and VTVM into a single unit. Field effect transistors replace the functions of the traditional vacuum tubes, providing better characteristics than the VTVM, without the need for ac line power. And, in addition to 7 ranges of ac/dc volts and 5 resistance ranges, the F-14 also measures dc current in 5 ranges from 100 uA to 1 A full scale.

Special features include: very high input impedance; 15 megohms shunted by 14 pF on dc volts; 10 megohms shunted by 29 pF on ac volts. Ac volts provides a broad bandwidth from 10 Hz to 10 MHz at 3 dB points without an accessory probe. The meter face includes scales for ac peak to peak voltages, a zero centered, plus and minus volts for servicing contemporary solid state circuitry, and a mirrored strip for optimum readout accuracy. Positive meter overload and FET circuit protection is incorporated to guard against incorrect voltage application.

The F-14 instruction manual includes construction details for some simple adapters to further increase the flexibility of the unit, such as a plug-in shunt to extend dc current measurements to 10 A, a switchable shunt for ac current ranges of 1, 3 and 10 A, and the accurate measurement of very small dc currents encountered in transistor, diode and capacitor leakage, in the order of nanoamps (0.001 uA).

This little gem weighs in at less than 3½ lbs. with batteries, and occupies about half the cubic space of the average VTVM, with a large 4½" x 3" meter face. The rugged all steel case is vinyl covered for an added appearance touch, and practical protection. Batteries required are standard types available at any drugstore or supermarket.

On the bench, in mobile or portable applications, anywhere you need to use it, the F-14 is instantly ready at a flick of the switch, with no warm-up period for stabilization. Oh, yes! I found some industrial type solid state meters in the catalogs offering similar capabilities -- at about twice the price of the F-14.

General Description

Meter: 4½", 100 uA, ±2%, diode protected and isolated from input.
Multiplier Resistors: 1% precision type.
Ohms Battery: 1.5 V "C" cell, Eveready type 1035 or equiv.
Power Supply Battery: 9 volt, Eveready type 222 or equiv.
Weight (less batteries): 3¼ lbs.
Dimensions: 5" W x 7-3/16" H x 3-1/16" D.

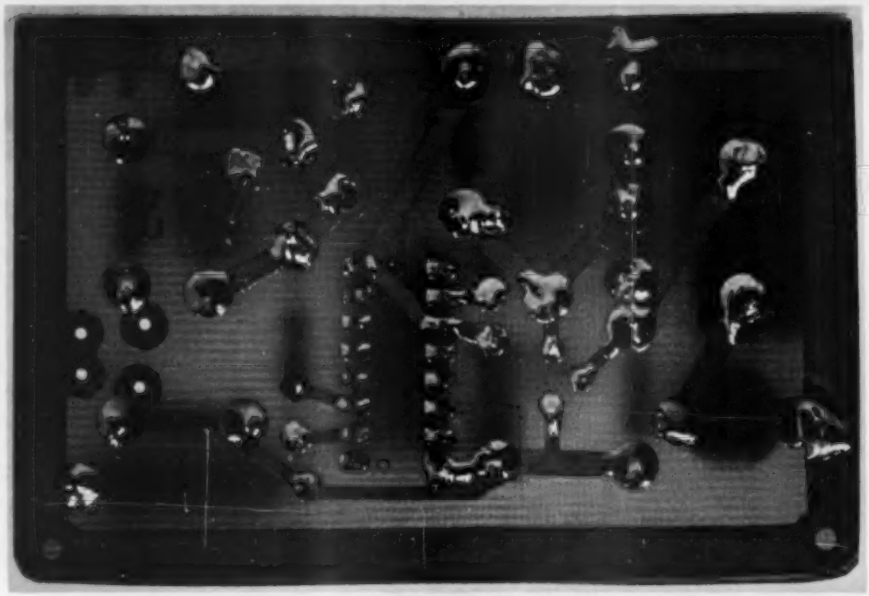
Peter A. Lovelock W6AJZ
Santa Monica CA

Go Tone for Ten

-- simple subaudible encoder

Carson Haines Jr. WB6GON
3112 Sylvan Ave.
Oakland CA 94602

The increased population of amateur repeaters and the resulting interference has forced many repeaters to use tone access systems. The tone burst system is irritating to users, and if a station drops out after accessing the system, there is no way for the system to be reaccessed until the next transmission. These factors led to the unit described in this article. The cost of reeds for a reed encoder is prohibitive for most amateurs ($15 for a new reed plus another $15 for the encoder), while this complete circuit can be constructed for approximately $10.



PC board.

Circuit Description

The unit (see Fig. 1) is a simple crystal controlled oscillator[1] driving a CMOS

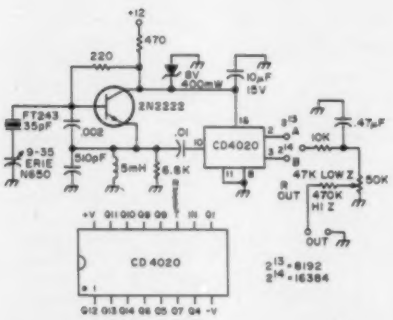
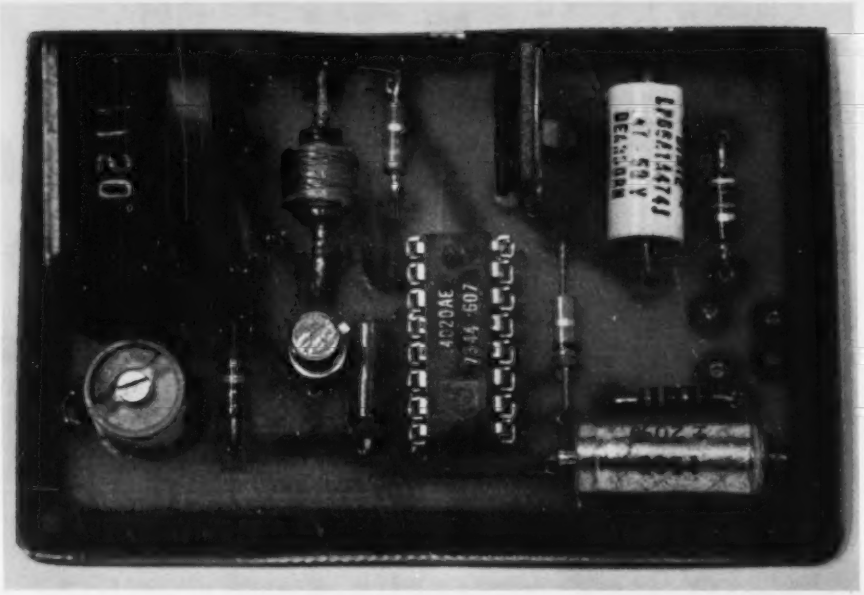


Fig. 1. Subaudible tone encoder.



Component layout.

divider with an RC filter on the output. The CMOS divider was selected so the number of components could be reduced from four 7490s and a precision voltage regulator to one CMOS divider with a simple zener voltage regulator.

In the units constructed, FT243 crystals were used. To calculate the frequency of the crystals, see the sample below:

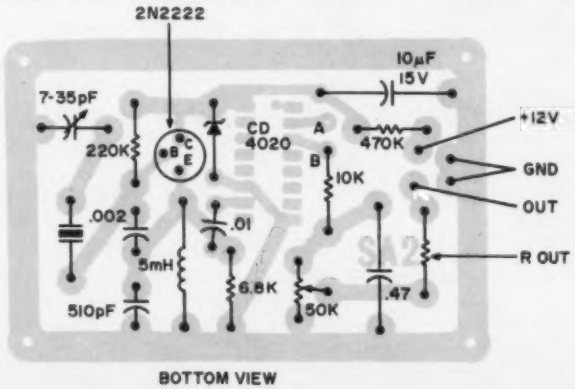
Required Frequency x Divide Ratio = Crystal Frequency
Example: 136.5 Hz x 8192 = 1.182 MHz

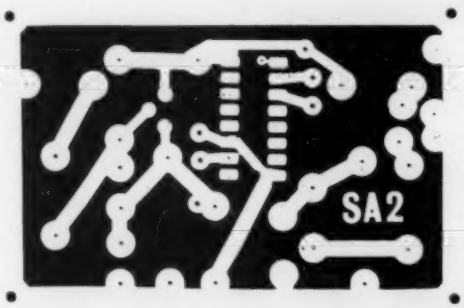
There are two divide ratios on the board, 8192 and 16384. If other frequency range crystals are available, simply bring out the required divide ratio from the IC and feed it into the filter. The crystals used in the original units were the least expensive crystals Jan Crystals had listed in their catalog. Pick a crystal frequency as close to the calculated value as possible. In our units for 136.5 Hz the closest crystal was 1120 kHz. This yielded an error of .2 Hz when the dividing was completed, and normal reed decoders are approximately ±1 Hz wide minimum. When selecting a crystal, try to keep the end error to approximately .5 Hz and you should not experience any problems. The oscillator is very broad band and crystals from around 100 kHz to 3 MHz should perform fine.

The dividing is done by a CMOS divider and it is available from Godbout Electronics. The CD 4020 has divide ratios of 2 through 2^{14} (16384) available and if other ranges of crystal oscillator frequency are used, it is possible to pick the divide ratio you require.

The output circuit is a simple RC filter[2] which takes the square waves on the output and makes them into a triangular waveform. The potentiometer in the output is used to set the output level, and the resistor value for the series resistor should be selected for the impedance into which you are inserting tone.

Fig. 2. Layout (bottom view) for subaudible tone encoder.





Construction

The unit can be constructed using any means available. The original units were constructed on PC boards and a full size layout is included (Fig. 2). Parts value is not critical, so select parts you have on hand that are near to the values listed on the schematic. The zener can be between 6 and 9 volts since the CD 4020 will run on any voltage between 5 and 15 volts.

Operation

Connect the unit to a source of 12 volts that is turned on when the transmitter comes on or let the unit run all the time (only 10 mA is required). Connect the audio and you are ready to go.

I will be happy to answer any questions you may have regarding this unit, but please SASE or no answer. ■

References

[1] *Ham Radio*, June, 1972, page 11, "Five Band Communications Receiver," M. A. Chapman K6SDX.

[2] *73 Magazine*, April, 1974, "Rock Solid Subaudible Tone Generator," Paul H. Wiese WA8YDC.

Parts Available From

Jan Crystals
2400 Crystal Drive
Ft. Myers FL 33901

Godbout Electronics
Box 2355
Oakland Airport CA 94614

SSTV BREAKTHROUGH

Robot Model 400

All solid state—digital random access memory SSTV Scan Converter

$695

- All solid state Random Access Memory.
- Slow-to-fast and fast-to-slow conversion capability.
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- Frame freeze from any standard CCTV camera, broadcast video or video tape source.
- Permanent picture storage.
- Automatic or manual TV frame snatch.
- Internal grey scale generator precision adjustment standard.
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Please send me complete information on your new Solid State SSTV Scan Converter.

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Address_____

City_____

State_____ Zip_____

LETTERS

from page 19

ground. The braid runs freely through the sheave and the job is done.

L. Colin Curtis VE7BMK
Kamloops, B.C.

You kind of coax the rope through the pulley, eh?

ADAPT OR PERISH

In your I/O editorial in the Oct. 76 issue of *73*, you wanted reader response to the content of *73*. Here's my 2 cents!

I have at one time or another subscribed to just about every ham magazine (yes, even *QST*). I presently subscribe to *73* and *Ham Radio*.

I have heard some OTs say that hams don't build anymore. They're wrong! There is more building going on now than ever before in ham history. True, we don't build receivers and transmitters like our grandfathers did, but then why should we? We can buy an excellent transceiver for a price for which it couldn't be built. It's downright stupid to build a receiver for $200 when you can buy it for $100. But I'm getting off the track. Suffice it to say that *73* is geared toward the builder. *QST* is not. I believe that *QST* is trying to please every ham all the time. If you want to read 16 pages of contest results, then by all means subscribe to *QST*. *Ham Radio*, on the other hand is an excellent magazine for the builder. But, and a big but, *HR* is not geared toward the average ham. The steelworker or autoworker who puts in a hard 8 every day doesn't have time or patience to get into anything too deeply. If I have some knowledge on a topic, I can usually follow an *HR* article. But when I'm completely ignorant about something, I look it up in *73*. That about says it.

A few words about the I/O section of *73*:

I think along with myself, most experimenters are baffled by all the I/O articles and ads. There's a lot of stuff for sale, but we don't know what to do with it.

At first, my opinion was that I/O material didn't belong in a ham radio magazine. Maybe it does or doesn't, but let's go back about 6 years ago. Back in 1970, something called TTL ICs were being advertised here and there in all the mags. We wondered what they were good for and why computer surplus should be in a ham magazine in the first place. Well, here we are just six years later and we can't live without the damn things. ICs do things cheaper, quicker and easier than any other means. They do things that couldn't practically be done any other way. Sure, I struggled for a few years buying ICs I didn't need, making mistakes (I still make them, but not as often), and building projects that never worked. We all have.

The point is this: Right now, I can't see a microprocessor in my future, but six years ago I didn't see why anyone needed a frequency counter. Boy, how wrong we can be. Wayne, I want you to know that even though I have been in electronics for 15 years, I am struggling through the I/O articles. I have to read them 2 or 3 times and they still don't make sense to me sometimes. I'm learning, not much, and not fast, but I'm learning. Keep cramming that stuff down our throats whether we say we like it or not. If you don't, who will? Certainly not *QST*. *HR* is already over most of us. Don't give us a magazine full of CB construction projects, because six years from now we'll wake up and find that the world has passed us by. I don't understand most of the I/O articles, but someday I will. At one time I didn't know the code. Now I do. That's life. To survive you have to adapt or you perish. I'll bet my grandfather had just as much trouble understanding a crystal detector as I have understanding a PROM. It didn't stop him and it won't stop me. Keep printing the I/O stuff and I'll keep struggling with it. Stop printing it and we'll all be crushed in modern technology.

Paul J. Dujmich WA3TLD
McKeesport PA

Ok, ok — I'll print it, I'll print it. — Wayne.

NOT PROPER

Several recent events have prompted me to write this letter. It concerns operation on two repeaters in Dallas on 147.36 and 147.39. Some of the operation I have witnessed on these two frequencies I do not believe to be in the spirit of amateur radio, and responsible operators in the Dallas area need to take note.

The repeater on 147.36 is listed in repeater directories as OPEN. Several of the group's members have personally told me that it was OPEN. Recently, as I was calling a friend of mine on .36 (my friend is a member of the group), I was asked to leave the frequency at once by a ham who heard my call. He said that he personally did not like me (I do not even know the man), and that anyone with intelligence knew that the repeater was CLOSED.

The repeater on 147.39 is a closed, private repeater. This group seems to be unable to tactfully get that point across. When I first got my synthesized rig, I did not realize that closed repeaters existed. I keyed up on .39, gave my call, and asked if anyone were around. My call was answered by a ham who said that it was a closed repeater and that outsiders were not allowed on frequency.

I believe that such operation is not proper in amateur radio, and that it can be greatly detrimental to our hobby. Hams who are concerned about keeping amateur radio as it was meant to be, should take a close look at these problems and others like them.

Blaine Hamrick WB5LSJ/WR5AKL
DFW Airport TX

NASTY WARNING

Regarding the interesting article "Have You Used a Triac Yet?" published in *73 Magazine* for October 1976 at page 76: I think a warning might be in order.

If a high voltage transformer were used as shown on page 77 with the resistor/capacitor across the triac, a person believing the triac "relay" to be open, and working on the power supply, might get a nasty shock, especially if the capacitor were larger than that shown.

I continue to enjoy *73* very much — keep up the good work.

Bill Allen W1LU
Providence RI

A little shock might be good for some of these five volt TTL kids.

COMM-ED

I noted the comments about Trigger Electronics. Let us not forget another company known as Dycomm, or Dynamic Communications, Inc. of Florida.

More than two years ago, after a phone conversation with Jim Penny, I ordered a front end crystal filter for my 81-21 repeater in Whitmore Lake. Upon arrival, I was astounded at its physical construction, being in a non-rf-tight minibox. Checks using professional Hewlett-Packard and Singer test equipment showed that it did not provide the 5 dB gain and sharp selectivity claimed, but in fact provided considerable loss with multiple response (passed more than one frequency). So much for $75. I sent the unit back and asked for one that worked or a refund. Months went by and no answer; finally, another phone call, and I explained the problem. Still no refund or unit. Now, more than two years has passed, and I have never received the unit or a refund. Insomuch as the repeater was moved to a nearby town and the equipment has changed, I have no need for a new unit. But my creditors sure could use the $75!

I also had a lot of problems with the various amplifiers they sold, too!

Henry Ruh WB8HEE
Whitmore Lake MI

MORE 20777

After reading "Belt Tightening" by Donald Chester K4KYV/1 in the July issue of *73*, I agree very much with him regarding AM and NBFM usage. These are about the cheapest means a ham has at his disposition to get on the air on voice on HF. Let us keep in mind that not all of us can afford to throw $600 on an SSB set. Besides, quite a number of foreign hams still use AM phone.

On one point I heartily agree with Docket 20777. I'd love to have back A-2, T-5, MCW on the HF bands.

Benjamin Lamboy KP4CA
San Juan, P.R.

ANGER TRIGGERED

Just a word of sympathy for Horace WA4CUD and Larry WA4MJA, along with the many others "shot down" by "the Trigger man."

It seems to me we can do nothing with this company as individuals. Perhaps you, or some of our "ham" friends, could come up with something we could do collectively. This company is "in to me" to the tune of $80, and I do not like the music they play.

Have tried the BBB (no luck), and am going to the Attorney General of New Mexico. Also have a file with the U.S. Postal Service.

Any other ideas would be appreciated. This company must be stopped.

Raymond E. Boshart WB5ROP
Box 1041 (712½ Ivy)
Truth or Consequences NM 87901

Trigger may soon be sent out to pasture — or else stuffed and mounted.

LEARNING A LOT

Just a short note to encourage you to keep printing everything about computers you can get your mitts on in *73*. At first it was all a mystery to me and I wondered what I was getting in my magazine, but once again (last time was 2 FM) I trusted you and, as a

direct result of *73*, I now eat, sleep and breathe computers. I am slowly stashing pennies, but it will be at least a year before I can assemble a system so I will have to read, learn and dream in the meantime. Please send me a year's subscription to *Kilobyte* and bill me before I change my mind. I am sure most of it will be above me, but like *73*, when my interests change or I become more knowledgeable, I would like to have the back issues to look through. I am in the electronic security business and will have a few articles forthcoming soon. I wish I could trade alarm stuff for computer stuff. Guess I'll have to use the money substitute being eroded by the government in the meantime – convert my alarm talent into a fascimile of a federal reserve note and later swap the note to someone for computer stuff. The government is trying to protect too many people. I'm tired of them trying to protect me. I have been buying kerosene in plastic storage bottles (government issue) for many years. Now it is illegal for me to purchase or store it in anything except metal. The government is protecting me.

Another subject . . . The secrecy of communications act. Several of my customers have silent holdup alarms in stores, banks, etc. These alarms call the police silently when they have a problem. Last week two of these alarms were tripped. I heard the call on the police monitor. Within 5 minutes my customer was on the phone wanting to know why the local newspaper had called wanting to know if they had been held up. This seems to me to be in violation of the act. My customer's life would have been in jeopardy if there was in fact a holdup taking place when the newspaper called. If the holdup man had answered the phone, I probably would have lost a customer and friend. The paper's employees sink hundreds of dollars into police monitoring equipment in their offices and cars to assure that they will be instantly aware of crimes and traffic accidents that are happening and be able to rush a photographer and reporter out. Nuff said. Thanks, Wayne; I'm really learning a lot from *73*. It's almost like an inexpensive and highly entertaining college course. Especially liked the articles about BASIC in the October (!) issue. All the I/O editors are great. If I can help in any way please feel free as always . . .

Steve Uhrig WA3SWS
Ellicott City MD

THE QRP CHAMP

K5JRN's QRP transmitter ("QRP Fun on 40 and 80," October '76) works like a champ. It was up and running into a random longwire two days after the magazine was received. My first home-built transmitter, 12 contacts so far in four days on mostly 80 meters . . . VA, DE, CT, and a 599 from MA. On 40, one contact in TN and IN albeit poor due to the frequency of 7148.5 fighting it out with Radio Moscow on 7150. I'm waiting for my General and I look forward to moving outside of the QRM-loaded Novice bands.

Thomas R. Sundstrom WB2AYA
Willingboro NJ

GOOD BUY!

Compliments. I have read many professional and hobby magazines, and I must admit *73* would be a great buy at twice the price. Each issue has lots of meat in it for many interests. Keep up the I/O section. I'm not into computers but I know I will be sometime in the future.

Kent H. Gibb VE6BAF
Edmonton, Alberta

Twice the price . . . hmmmm?

BEST IN THE WORLD?

My subject is Atlas Radio Company, headed up by Herb Johnson and his boys. I bought an Atlas 210X and had trouble with it; I sent it back and then it developed more troubles. One day I wrote a letter to Herb Johnson and explained the troubles. About two weeks later the UPS had a package for me from Atlas Radio. Yep, you guessed it; it was a brand new Atlas 210X, and as soon as I got the chance, I tried it out. It was hotter than a firecracker and some of the QSOs I had were as strong as a base station. You see, I am trying to get Bicentennial WAS from a car, and that is quite difficult with a wet noodle for an antenna and just 100 Watts output. I believe that there is not any other ham radio manufacturer who would do what Herb Johnson did, and I believe that Atlas Radio is the best ham radio company in the world.

Russell "Bud" Holderbaum, Jr.
W3AEZ/W4JIQ
Gaithersburg MD 20760

TRUTH OR CONSEQUENCES

Thanks for the latest *73* addition, the hard copy reader service card.

Keep up the IC projects. I built the HR-212 on page 66 of the May '76 *73* mag. The article says to scan 6 channels, but without any mods using 0 for 8, up to eight channels can be scanned. Also, by adding an AND gate, ten channels can be scanned. Works FB. Oh! By the way, would like to see a small article on how to make the HR-212 hang in there (delayed scan) on active channels. Also a source for printed circuits to be used with the articles!

I see for the last 2-3 months ads missing from Altaj Electronics, Dallas. I ordered their King clock and only after 4-5 weeks delay and two telephone calls, was able to get delivery. But since then, I have done business with them and have gotten prompt, courteous service. James Electronics is another story. They have *same day service*. So far I've placed 2 or 3 orders with them and have gotten them back (including postal time) within six days. FB!

How about mentioning the *Fox Tango Newsletter* put out by The International Fox Tango Club, Milton Lowens WA2AOQ/4, 248 Lake Dora Drive, W. Palm Beach, Fla. 33411 at $5 per year (10 issues). Its sole purpose is the exchange of info, mods, etc., for Yaesu owners – a terrific letter. Well, that's it for now.

Tom Gundlach WB5JDU
Truth or Consequences NM

MORE IN THE FUTURE

About your article "QRP Fun on 40 and 80" (Oct. 76) by Si Dunn K5JRN. GREAT! I thought that I had to buy all of the old radio mags to find this kind of make-use-of-your-junk-box gear. Hope to see more in the future. This type of article makes ham radio a challenge.

Terry D. Wright
WB8UPO/ADM8UPO
Piqua OH

MORE OF THE SAME

The article by Gabriel F. Gargiulo (October, pg. 128) was the best on programming in this issue, I thought. It was very clear and instructive. Also, your I/O editorial points out the computer's potential. Let's have more of the same.

Ken McGinnis
San Mateo CA 94401

PLAIN ENGLISH

I wish *73 Magazine* would (for once) show a construction article which was written in plain English! Terms like TTL, PLL, coil phasing (in one article it said "The coils must be properly phased so the circuit will oscillate," but never mentioned what phasing means or how to do it). ½λ, etc., etc., make the average Novice's (or at least my) head spin.

You should put one article in each month's issue designed especially for Novices (simple and educational). I, for one, would like to design my own circuits for different projects, but can't because of lack of knowledge. These articles would help people learn theory and at the same time show them some sort of practical use!

L and C circuits always give me trouble. Figuring the proper value of L and C for different frequencies is murder when you're only an 8th grader (soon to be 9th grader).

I hope other Novices who see this (if you print it) will support this idea or improve on it.

John Halliwell
Hampton TN

P.S. I have 5-9 weeks to go before I get my Novice license. I love your magazine. Keep it up.
P.P.S. I want to mention that Optoelectronics is a great dealer. Their service was fast and their electronic clocks work great!

TEST PILOTS ONLY

Nearly every issue contains subscription offers for expanding *73*. I would like to propose another way in which new blood can be brought into the fold. Why not have a WN section similar to the I/O section that will teach us neophytes the basics of building the kinds of ideas that the more advanced hams submit?

After people see that top-notch authors are penning stuff they can read, they'll run out and hopefully get a life's subscription.

I would also like to see an article to review 2 meter operations and a few on uP fundamentals.

James Wessels, Jr.
Louisville KY

Sure, James, I'd love to have more articles on fundamentals for Novices, but life subscriptions are going to be permitted only to amateurs over 73 years old who are full time test pilots. Some readers think we've already run enough 2m operations articles, but there sure is a thirst for uP material. – Wayne.

ANOTHER CHARTER

I was unable to give you my subscription to *Kilobyte* at the computer convention this past weekend.

After seeing how well you started *Byte Magazine* out, I am sure your latest venture will be as good or better.

Please accept my subscription to *Kilobyte* for a three year charter membership. Enclosed is my check for $25.00.

Carl G. von Loewenfeldt
Alexandria VA

KING AND QUEEN

Just a few lines to let you know that Lloyd Colvin W6KG and Iris Colvin W6DOD have returned to California, via Australia, Western Samoa, American Samoa and Hawaii, after a

Continued on page 39

ME-3 microminiature tone encoder

Compatible with all sub-audible tone systems such as: Private Line, Channel Guard, Quiet Channel, etc.

- Powered by 6-16vdc, unregulated
- Microminiature in size to fit inside all mobile units and most portable units
- Field replaceable, plug-in, frequency determining elements
- Excellent frequency accuracy and temperature stability
- Output level adjustment potentiometer
- Low distortion sinewave output
- Available in all EIA tone frequencies, 67.0 Hz-203.5 Hz
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- Reverse polarity protection built-in

$29.95 each

Wired and tested, complete with K-1 element

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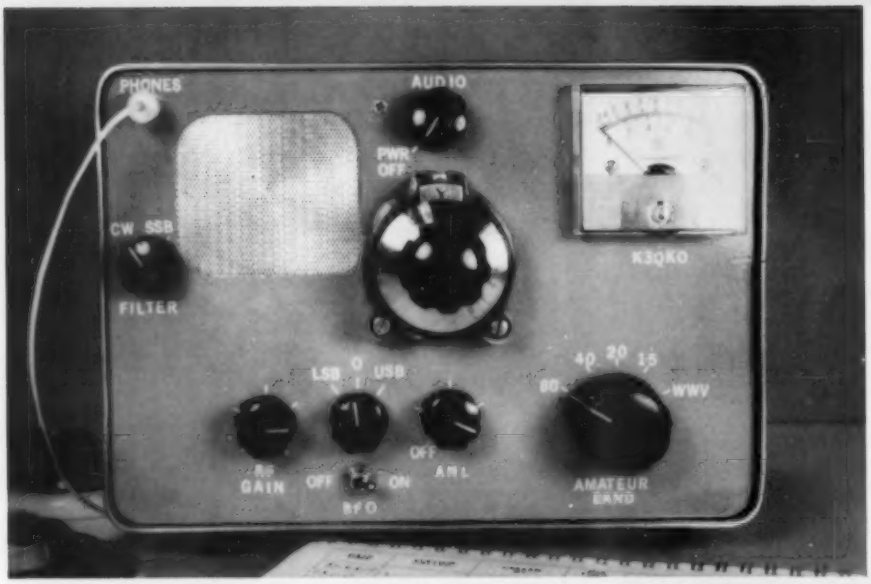
K-1 FIELD REPLACEABLE, PLUG-IN, FREQUENCY DETERMINING ELEMENTS

$3.00 each



Complete five band dual conversion amateur communications receiver.

World's Simplest Five Band Receiver?

-- using an AM transistor radio

Warner F. Stortz K3QKO
5122 Alberta Ave.
Baltimore MD 21236

I am sure many radio amateurs who have home brew rigs would love to have a matching receiver. Deciding to do something positive about this emptiness in the shack, I came up with a plan that made the home brew receiver not only a possibility, but a reality.

The plan centered on reducing the complexity and time of construction dramatically by using a drugstore transistor AM broadcast radio set as the main building block. Even if you never start to build this receiver, I am sure that you will find it comforting to know that if it ever became necessary, you could do it.

This receiver, being a dual conversion type, has two local oscillators (LO) and two intermediate frequency amplifiers (IF). In this circuit we have to make our own HF LO, while both IF amplifiers and the MF LO are parts of the AM broadcast set.

We also have to make six other circuits to support our BC set to make certain that our project winds up a real communication receiver. These are the HF radio frequency amplifier, 1 MHz amplifier, beat frequency oscillator (BFO), S-meter, crystal filter, and automatic noise limiter (ANL).

When all the circuits are working together, their operation is spectacular for such a simple design. When the rf gain control is two thirds up, a 0.2 microvolt 7.1 MHz signal at the antenna connector will read S9. The receiver noise is too low under these conditions for me to make a measurement with the simple equipment available to me.

All I can say about it is that I could hear only signal in the phones, and I just finished working F6ARC on 40 meters with no trouble at all. Any dual conversion birdies are less than S2 and located so they are no bother.

Drift and broadcast station feedthrough is nil. Each of the five bands can be selected by a front panel control and is 0.9 MHz wide. The 6 dB down bandwidth signal selectivity is 300 Hz with the phase control in the CW position, and 1.2 kHz in the SSB position. It is powered by a 9 V battery and the current drain is 30 mA.

Circuit Description

The transistor AM broadcast set just keeps on doing what it did before we bolted it to the front panel – changing .55 MHz to 1.6 MHz rf to sound at the speaker or phones – so there is no need to describe it any further. Fig. 1 shows how it works in our receiver and is supported by the outboard circuits. These will be described in

detail because each is unique in this receiver.

Starting from the antenna connector, Fig. 2, the bandswitch, S1, selects one of the rf transformers, T1-T5. They are broadband-tuned to the center of the desired frequency range. Therefore, all the signals in the frequency range selected appear at the gate of rf amplifier Q1. Here they are amplified as much as possible without adding noise to the output. By using a low noise MOSFET for this amplifier, the receiver signal-to-noise ratio is greatly improved.

To prove this point without a lot of rotten math, it is logical that if the rf signal is made greater, the following gain controls will have to be turned down to yield the same output that was present before amplification. If noise was not added in the amplifying process, all the frying sounds generated by these turned down stages will be much less.

The output of the rf amplifier is inductive coupled to the gate coil of the converter transformer, T6-T10, and selected by the bandswitch, which, also through other poles, applies this signal to gate 1 of the HF converter Q2 (along with the HF LO output to gate 2).

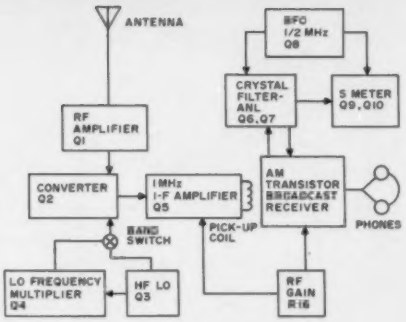


Fig. 1. Block diagram.

The HF LO is crystal controlled for stability and uses FT-243 type crystals. The 20 meter, WWV, and 15 meter bands are at a frequency higher than that at which these crystals will oscillate, so a multiplier is used to double or triple their fundamental output when the bandswitch is in these positions. This multiplier is a class C amplifier whose output is tuned to the selected frequency with rf chokes and fixed capacitors.

Now things really start to happen. While the converter Q2 is doing what is natural, its output is a real mess of signals, and we are only interested in the ones that are the difference between the LO and rf frequencies.

The unwanted signal that will cause the most harm is the very strong one at the LO frequency. If it gets into the BC set loop stick, overloading will take place and there will be birdies all over the bands. To stop this LO feedthrough, the converter output is filtered by using a well shielded oscillator coil, T11 (Fig. 3), removed from another BC set, and tuning it with a fixed capacitor to about 1 MHz.

Because of a long coaxial cable run to this improvised transformer, Z1 was fabricated to swamp any VHF parasitics that might develop. The base of the 1 MHz amplifier Q5 is connected to the pick-up coil in T11, resulting in a clean converted signal being amplified. It produces a strong field around rf choke L8, which is tuned to about 0.8 MHz with fixed capacitors.

This choke is mounted close to the BC receiver loop stick so its field will be picked up with little attenuation. Strong spurious signals (birdies) are unacceptable. Therefore, the importance of keeping the HF LO signal out of the BC set, and the BC LO signal out of the HF rf amplifier cannot be overemphasized. Most of the receiver shielding and parts placement was made to achieve this isolation.

The broadcast receiver is now able to tune and detect the different HF signals that have been converted to frequencies that are within its range. It is still not ready to be used for a reliable contact, because it needs at least a beat frequency oscillator and more selectivity.

The BFO is a series-tuned Colpitts type. It uses a transistor BC set IF transformer for the frequency controlling element and a front panel controlled capacitor to vary the pitch. Its output is taken from the small untuned winding in the IF transformer.

The receiver's fine selectivity is achieved by connecting a crystal filter between the collector of the BC set's first IF amplifier transistor and its output transformer. To implement this, the collector lead is disconnected from its original place, and reconnected through a coaxial cable to another identical IF transformer located on the ½ MHz crystal filter and ANL circuit board (Fig. 4).

This transformer, T12, provides the input for the FT-241 low frequency crystal Y6 and the 180 degree out-of-phase signal for the phase control C20. When C20 is critically adjusted from the front panel, stray signals shunted around Y6 are canceled and the filter output

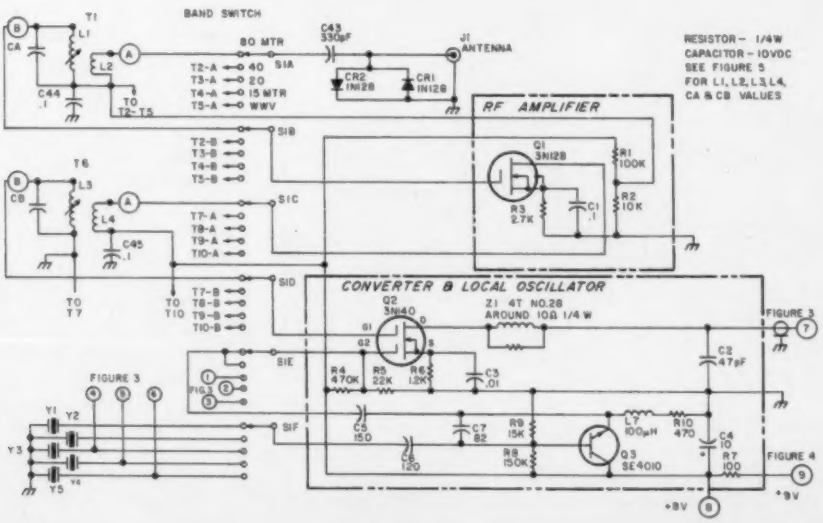


Fig. 2.

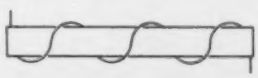
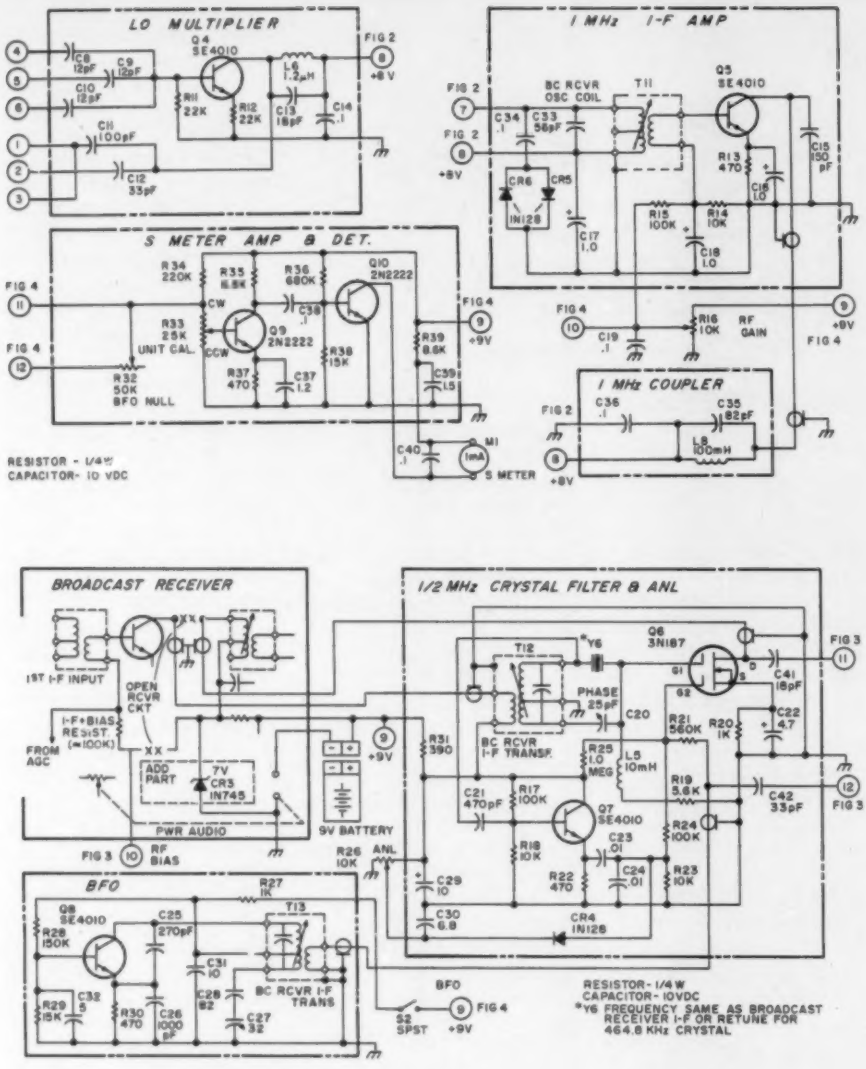


Fig. 3.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S METER AMP & DET.
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1/2 MHz CRYSTAL FILTER & ANL
BFO
RESISTOR - 1/4W
CAPACITOR - 10 VDC
*Y6 FREQUENCY SAME AS BROADCAST RECEIVER I-F OR RETUNE FOR 464.8 KHz CRYSTAL

Fig. 4.

COIL - CRYSTAL TABLE

BAND (METERS)	RECEIVER FREQUENCY RANGE (MHz)	RF AMPLIFIER TRANSF. SYM.	TURNS L1	TURNS L2	WIRE (AWG)	CA (pF)	CONVERTER TRANSF. SYM.	TURNS L3	TURNS L4	WIRE (AWG)	CB (pF)	CRYSTAL HF LO SYM.	CRYSTAL HF LO FREQ. (KHz)
80	3.13 - 4.18	T1	65	4	28	33	T6	65	7	28	47	Y1	4735
40	6.30 - 7.35	T2	42	2	28	47	T7	42	4	28	56	Y2	7900
20	13.35 - 14.40	T3	24	2	24	15	T8	24	3	24	47	Y3	7475
15	20.50 - 21.50	T4	14	1	24	6.8	T9	14	2	24	33	Y4	7350
WWV	14.40 - 15.40	T5	24	2	24	12	T10	24	3	24	39	Y5	7975

COIL DIAMETER - 1/4 in. (.635cm). CRYSTALS - FT-243 PRESSURE MOUNT TYPE. L2 = 1mm. FROM L1 RF GROUND SIDE. L4 & L3 SAME SPACING: CA, CB, L1, L2, L3, & L4 SHOWN ON FIG. 2

Fig. 5.

has an extremely narrow bandwidth.

When it is closed, it sends a strong signal around Y6 and the bandwidth is useful for SSB communication. The output of Y6 is kept at a very high impedance and connected to gate 1 of Q6. Gate 2 has the BFO output and the ANL bias feed to it. The BFO is mixed with the IF in this manner to prevent strong signals from pulling its frequency.

The gain of Q6 is regulated by the amount of ANL bias at gate 2. Its drain is connected through another coaxial cable back to the BC set IF transformer at the original collector connection of the first IF amplifier transistor. This completes the IF amplifier circuit again, but with the crystal filter, ANL, and BFO added to it.

To develop the automatic noise limited bias, the IF signal at the input of the crystal filter is transformed to a low impedance by Q7 and diode CR4 changes it to negative dc, filtered by C24. This diode is biased to different values above cut-off by the front panel control R26.

When the signal exceeds this bias, a negative voltage is developed which is subsequently fed to gate 2 of Q6.

The gain of Q6 will vary with a noise pulse all the way to cut-off, depending upon the setting of the ANL pot R26. The diode limiters are also part of the ANL but they are not adjustable. The main function of CR1-CR2 is to prevent serious overloads from damaging any components when the transmitter is keyed, and that of CR5-CR6 is to prevent audio distortion.

The S-meter circuit has an unusual input network that nulls out the BFO component of the IF signal so it will not deflect the meter. This is accomplished by adding the exact amount of 180 degree out-of-phase BFO power to the input of Q9 (Fig. 3).

It might look like a marginal balance, but I have not had to change the original adjustment of R32, and a year has passed without the meter being slightly deflected by the BFO. The rest of the circuit is conventional with a voltage amplifier Q9 followed by a collector detector Q10 that deflects the meter.

The final two modifications require soldering inside the BC set. One is to add manual IF gain control to prevent overloading, and the other to stabilize the collector voltage that feeds the MF LO to prevent modulation and drift. To locate the

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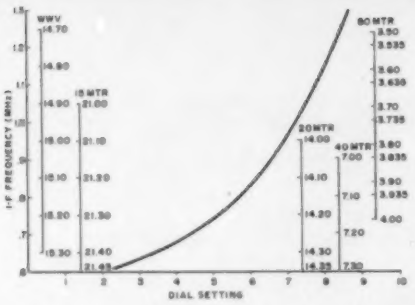

Fig. 6. Typical calibration chart.

proper place to do both jobs will take some looking around.

A zener diode, CR3 (Fig. 4), is connected across the large capacitor on the load side of the decoupling resistor feeding the collector power to the rf circuits. The resistor is about 100 Ohms and the large can type capacitor makes it fairly easy to locate.

Next you will have to find the forward biasing resistor of the IF amplifier base bias divider. My receiver has only one IF stage and it was no trouble to find. It will be about 150k and it feeds the power we just stabilized through the AM detector diode, which also doubles as the AGC generator, on to the cold side of the IF transformer base winding. This resistor is disconnected from the stabilized voltage and reconnected to the wiper of the front panel controlled rf gain pot, R16 (Fig. 3).

Construction

I assembled my receiver on a 15 cm x 10 cm x 5 cm (6 x 4 x 2 inch) chassis having a 18.4 cm x 12.7 cm (7¼ x 5 inch) front panel. The transistor AM broadcast receiver was selected because of its tuning dial and volume control layout. The negative side of its battery was connected to the ground plane, and the speaker opening was covered with a gold metal screen that would make a pretty good shield.

I found later that it had only one IF stage, but this certainly did not affect its sensitivity or degrade the project. The BC set must have extension shafts epoxied to its tuning and volume control dials so they can be operated outside the front panel. The new tuning dial is a vernier type and had to be mounted on a 1.1 cm (7/16 inch) homemade spacer so it would fit on the capacitor shaft.

The front panel controls, S-meter, speaker, and phone jack are located so that they are easily accessible. After the BC set has had its IF retuned to match the filter crystal, it is fastened to the front panel with two #2-56 bolts. One of the bolts has a solder lug under its nut so the BC set ground plane can be connected to the metal front panel through it.

The outboard circuits that convert the BC set into our communication receiver are made on pieces of "vector" breadboard material, and the components are soldered to press-in terminals. They were all made as small as possible and tested before they were mounted, using spacers, in the main chassis.

The bandswitch has two levels with three poles on each. All rf amplifier connections are kept on one level, with converter and HF LO connections on the other. A lot of effort was spent trying to keep the leads short and separated from each other, but it still turned out a mess. However, it works better than anyone could have imagined. I used #22 AWG solid insulated wire for the interconnections, and bare wire for the jumpers.

All rf transformers are mounted on the top of the chassis and are well shielded. The converter transformers are preassembled on a plate that fastens to a flange around a cut-out in one end of the chassis. These coils project into the underside of the chassis, isolating them from the rf amplifier input. The tuning is broadened by the heavy loading of both sets of coil with more primary (untuned) turns than would be used for high Q operation.

I used as much shielding as I could make without getting sick. It is very important to keep the outputs of the two local oscillators out of each other's converters, and the BFO harmonics out of the HF rf amplifier.

The cabinet is fabricated out of aluminum sheet and provides the shielding needed to keep out broadcast station signals. The front and rear panels are marked, after painting, with Datak dry letter transfers, and then sprayed with clear plastic to prevent them from being worn off. When the wrap-around top, bottom, and side piece is buffed carefully, the receiver has a professional appearance.

My semiconductors were selected because they were readily available to me. The SE 4010 transistors came from an old printed wiring board bought from a mail order house. When I ran out of these, I used 2N2222 transistors from another board.

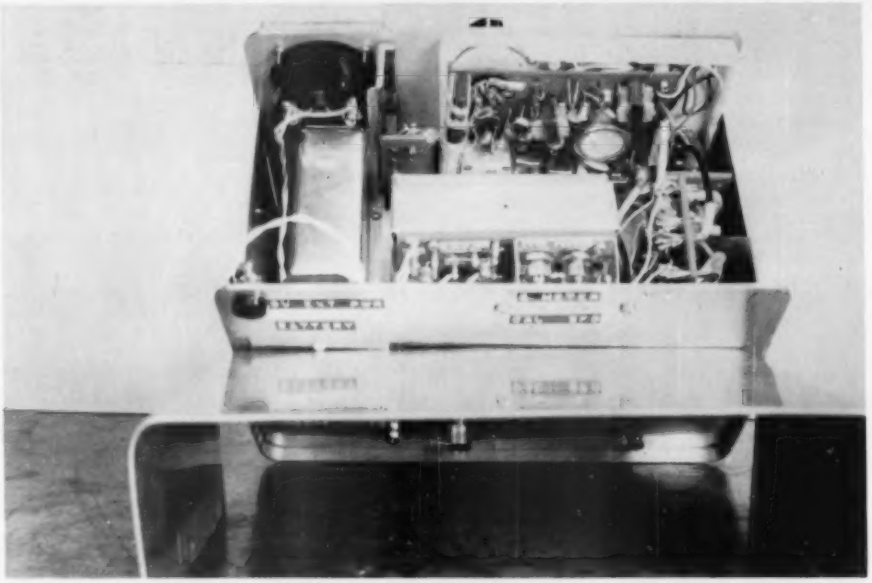

Fig. 7. Looking toward front panel with top half of cabinet removed. Top, left to right: S-meter, 1 MHz coupler next to loop stick antenna, AM broadcast set. Bottom: HF LO crystal shield, S-meter amplifier over the rf transformer shield, crystal filter and ANL circuit board.

Both are replaceable with Motorola HEP55, a NPN rf transistor.

The MOSFETs, Q1, Q2 and Q6, are the contents of a Radio Shack Archer Pack #276-628 called "Three MOSFET N Channel Transistors." You must watch how you solder these units in place. Keep all the leads shorted together during the process or the gates will surely be ruined. After they are in place nothing seems to be able to keep them from working.

Alignment

I aligned the tuned circuits of my receiver using equipment commonly found in the ham shack. Operation one is to tune the rf and converter transformers to the center frequency of their bands using a grid dip meter for an indicator.

Next, you must have the shields fastened into place, power switch placed on, rf gain turned fully on, audio gain one quarter up, ANL off, BFO off, phase capacitor fully closed, and the antenna input supplied with a signal from a VFO. The coupling must be very loose to the VFO.

The coupling recommended is two 50 Ohm resistors side by side, one fed by the VFO and the other across the coax connected to the receiver antenna terminal. There is no hard electrical connection between the two resistors (only the rf field), and the spacing between the two should be variable.

Back on the receiver, an oscilloscope is connected to the input of the filter crystal, Y6, using a high Z probe. The slugs in T11 and T12 are centered, and the bandswitch set to the VFO frequency range. The VFO or the receiver dial is varied until the rf is picked up and a ½ MHz IF signal is seen on the scope. T11, T12, and the rf converter transformer combination, when switched in, are adjusted until the IF signal is maximum amplitude.

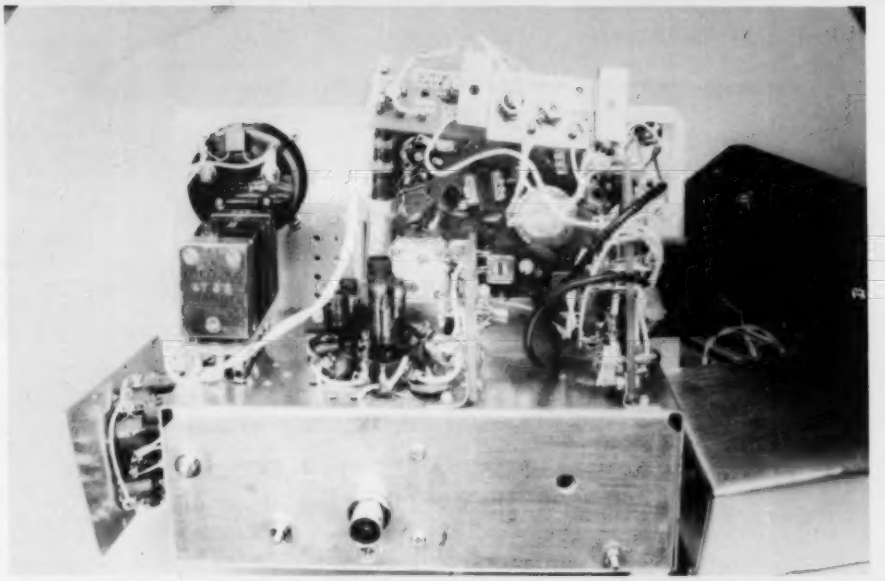

Fig. 8. Looking toward front panel with all shields removed, along with cabinet. Left to right: converter transformers on loose panel, HF LO crystals on home brew holder, 1 MHz coupler, rf transformers, rf amplifier, BC set, S-meter amplifier, crystal filter, ANL board.

The rf gain should be reduced along with the coupling to the VFO during these adjustments, to keep the scope presentation at an amplitude easy to see but not overloading the circuits (about a volt peak).

Connect the scope probe to the drain of Q6 and retune the receiver dial for a maximum display. Set the phase capacitor to its minimum bandwidth position, which is found by moving the VFO dial around the detected frequency. Move the scope probe back to the input of Y6 and tweak up T12 and the first BC set IF transformer so that their bandpass is centered on Y6's frequency.

Connect the scope to the output of the last BC set IF transformer and tweak up the remaining BC set IF transformers so they are also center tuned to Y6's frequency. The BFO is switched on, the pitch capacitor centered, and the slug in T13 adjusted for a zero beat, noted at the scope and the

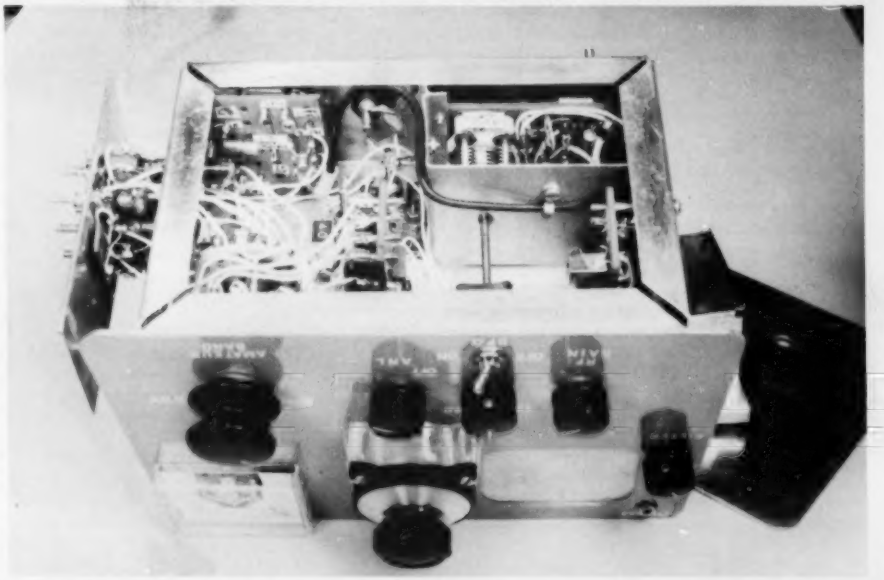

Fig. 9. Underside of chassis. Left to right: converter transformers on loosened panel, HF LO converter circuit board in back of bandswitch, LO multiplier, BFO in back of shield, 1 MHz amplifier.

tone at the speaker.

The last and simplest adjustments are made to the S-meter calibration pots, R32 and R33. Without an rf signal being applied to the receiver input, rotate R34 fully clockwise, place the BFO switch on, and adjust R33 to a position where M1 indicates zero. When an rf signal is present, M1 will deflect to a value proportional to its power. There is no clear-cut amount of rf power per S unit, so set R33 to a place where what you believe is a S9 signal in the phones reads S9 on the meter.

If you use a dial marked 1 through 100 like I did, a calibration chart will have to be made. One curve, and only one, is needed for all bands, because the BC set does the tuning each time. Fig. 6 shows how an easy-to-read chart may be laid out. The points for the curve are located by picking up the output of a 100 kHz crystal calibrator, and knowing the frequency of the converter crystals. Subtracting the HF rf frequency from it will locate the band scales on the chart.

Conclusion

This whole project was a very satisfying success. However, you could always do better if you had a second chance. The next time, I would replace the FT-243 style crystals with smaller devices, even though it would run up the cost.

Also, their frequencies would be such that the LO multiplier could be eliminated, reducing the battery drain by 5 mA. I believe that I would make the front panel larger to accommodate a different type of dial. I cannot find any fault with the semiconductor devices or the BC set, so I would stick with them.

In fact, the whole receiver fits and works so well beside my keyer that I am in no hurry to change anything. ■

Ham Help

Many people express an interest in ham radio, but find it difficult to locate a ham to answer their questions, peak their curiosity, and enroll them in a local area class. As public pressure for our frequencies increase, we must increase both our public awareness and our numbers in order to survive and grow. Through a new program called Ham Help, we hope to be the link between the prospective ham and you, the local radio club, the neighborhood ham, and the nearby radio class. Here's how it works.

A prospective ham will call the Ham Help number, ILL-1676. The 24 hour line will be answered by John Russell WB9UEC, Ham Help Chairman, or an answering machine. After getting the name, address, and phone number of the prospective ham, John will call a volunteer ham in the prospect's neighborhood. The volunteer will, in turn, call the prospect, and, hopefully, take a personal interest in the newcomer.

A program like this will obviously only succeed if all area clubs will volunteer information on area classes and keep the Ham Help file current. Here is what your radio club can do to help make it work:

INFORM: Call the Ham Help line to let John know about classes – include specifics such as dates, times, location, and who to contact. Please don't assume we have all the information we need; we can only get it from *you*. Continual updating of class information is essential for the program to work.

REFER: Refer others to Ham Help. We will be glad to be the clearinghouse for all classes in the area. Have them call ILL-1676 and we'll take it from there.

VOLUNTEER: We need volunteer hams to call back prospective hams that may call from your area. Invite them to your shack. Tell them about a class in your area (John will give you the info). Bringing a new ham into the fold is a rewarding experience that is good for you, your radio club, and the hobby. Call in to Ham Help and volunteer your services as an "Elmer" in your area. If your club would like to handle all requests from a certain area, let John know, and we will be glad to refer prospects to you. A good way to increase membership in your club!

Let me stress that, though CFMC is funding this program, we wish it to be a truly inter-club project. The Chicagoland area is ripe for a program of this type. Our hobby is the finest in the world – it's time we began to show it off!

Only through your club's (and its members') participation can Ham Help work. We ask that you print this in your bulletin or newsletter, and announce it at your next meeting.

We are banking on your continual support of Ham Help to make this program a huge success, and to bring new blood into our hobby and our clubs.

Rich Casey WA9LRI
President
Chicago FM Club
Arlington Heights IL

By way of background information: I am 67, still hold a lifetime FCC permit to operate on the former marine 2 to 4 meg band, hold the first renewal of my CB license (but have become disenchanted with that crowd and do not operate my Johnson 323 Messenger), have built a half dozen Heathkits (from stereos through VTVM to tachometers), and have just been nudged by a summertime neighbor, whose permanent address is Cleveland, to seriously approach ham radio. I have one of his back issues of *QST* and the July '76 issue of *73*.

Up here in the puckerbrush at Bridgton, Maine, amateur radio is practically unknown. I can't find a soul who can give me counsel.

I have written ARRL for a half dozen books (not yet received), and have ordered from Heath a starter set of code practice records and practice key toward going for Novice, or if I have enough practice time, to try for General in one jump.

From my copy of FCC Rules and Regs, Vol. VI, I have found Bangor, Maine, is the semi-annual location of examinations. How do I find out when and how much? How do I find out if there's a General in the area who could examine me for Novice?

How do I find out – in a HURRY – what licensed hams have known for a long time? Huh? Time is of the essence, because on this side of 60 there's a hell of a lot less of it remaining than there was on the front side!

From what little I know now, 80 through 10m is the spectrum that interests me, and I am looking for a used receiver, 5 band, SSB, all solid state, in perfect working order, to do a little listening, and to gather some education on the way. To get some good out of it, an antenna is a prerequisite, and some ideas on a simple dipole which I can hang between a couple of trees would be most welcome. Lightning arrestors, which are effective, are a must in this mountain country, where it gets pretty "snappy" now and again.

As you can plainly see, I'm not asking for much help, just the whole ball of wax!

Whatever assistance you may be able to provide would be most welcome. Thank you very much.

Charles A. Jurack
P.O. Box 145
Bridgton ME 04009

For those in our area needing help for Novice through Extra, please contact: Carthage Amateur Radio Society, c/o Mr. Dan Waters, Vocational Education Bldg., 6th and River Streets, Carthage MO 64836.

We meet each Wednesday evening at 7 pm local time at the vocational building.

Howard Gravitt W9CZT
Carthage MO

I really enjoyed your articles about computers in the Aug. 76 issue of *73*. I am 14 years old, and before we moved to Texas, I used to be real good at computer programming. The middle school that I used to go to had several terminals connected via telephone to the main computer at Westfield High School. The computer was a "Digital" PDP/11, BASIC language. The school I went to taught computer programming starting in grade 6. (The name of the school is South Middle School.) When we moved here, I found out that computer programming is not taught until 11th grade! If there is any way that I can use a computer near here, will you please let me know? I really enjoyed computer programming in BASIC language and would love to do it again.

Tom Trusty
2613 Lynnwood Dr.
Arlington TX 76013
(817)-274-7998

P.S. I am waiting for my Novice call to come back from the FCC. I took the written test about 1 month ago, and the code test a few weeks before that.

I think amateur radio is great, and I would like to add my name to your Ham Help list. I am willing to help any interested person get started in amateur radio in the Michiana area. All they have to do is drop a line to me.

Ron Lula WB9WXO
55428 Meadowview Ave.
South Bend IN 46628

We would appreciate it if you would list us in your "Ham Help" column. *73* is a lot easier to read than *QST* because it is at our level. We already have 2 receivers, but they are not very good. Thank you very much!!!!

Mark and Dave Buda
120 Pierrepont
Dunlap IA 51529
(712)-643-2273

I need help in Colorado (for Novice).

Mark Pollard
710 Mohawk
Box 3345
Boulder CO 80303

I need help to get into amateur radio.

Tom Griffith
Sequoyah Estates
Morristown TN 37814

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How Do You Use ICs?

-- part IV

To those who are used to struggling with the vacuum tube version of the electronically regulated power supply, the IC voltage regulators can be quite an experience.

Within the realm of what is possible when working with any infernal electronic device, to know them is almost to love them.

While they come in a wide variety of sizes, shapes and internal configurations for specialized purposes, most of the jobs that the beginner and even the more advanced builder would have can be handled with only a few of the most commonly available types.

Here comes the fun part. Using these IC regulators is almost as simple as plugging in a transistor. The ones of most interest are three terminal devices and require only a few external parts.

The IC regulators are classified as linear devices. While there are a number of ratings which might apply, and a number of ways to get a more complex regulator using them, it is the simple way we want to explore.

As most of this series has been devoted to the digital ICs, the first voltage that would be of interest is the regulated five volts dc that the digital ICs require.

For this job there are two very common regulators which you will find in many of the circuits. They are the LM309H and the LM309K. (The LM109H, K are almost identical and are also commonly available.)

As can be seen from the numbers, they are very similar to each other. There are two practical differences between them: the package they are in and the power they will handle.

The LM309H is in a T0-5 transistor type package and will handle about 200 mA. The LM309K is in the T0-3 type package and will handle an Ampere of current.

Fig. 1 shows the pin configurations of the two. These are from the bottom of the package. While the DIP (Dual Inline Package) ICs are counted from the top of the device, these are from the bottom, like transistors.

This may be confusing until you get used to it, since you may be working from the top with a breadboard matrix or other construction technique.

With just three pins, you don't have a lot of choice to make. One is the voltage input, one is the regulated output and one is the ground connection. It would be hard to go wrong. Just make sure which pin is which.

Fig. 2 shows how the device hooks into the power supply circuit, and its basic external components. While the device can be used with as high as 35 volts input, there are dangers to doing this which will be explained later. Assume that the supply shown is in the nine to twelve volt range.

It is very important to understand the purpose of C2 and C3. They are not there to supply additional power supply filtering in the ordinary sense. A typical value for C1 would be in the neighborhood of 5000 uF, so the two additional capacitors with those values would have miniscule effect.

The technical data lists them as optional and not being needed for all applications, but don't you believe it. So what are they there for?

Specifically, they are there to prevent self-oscillation of the regulator IC and to prevent external pulses from upsetting internal operation. Self-oscillation?

A simple transistor regulator consists of a pass transistor to handle the current, controlled by several signal type transistors. As the voltage varies, it creates a signal which goes to the control circuitry which tells the pass transistor what to do to hold the voltage steady.

The LM309 has about 19 transistors and a heap of other parts in it. Even though there are only three pins on the outside, there is a whole lot going on inside.

As with any transistor, there is always the danger of it breaking into oscillation since it has the overall effect of being a high gain device.

This also means that it is susceptible to pulses from the outside getting in to cause trouble.

Even though this may not be a problem in all cases, the reports of IC equipment and experimentation so far have come up with another reason why they should be used as a matter of course.

ICs seem to find the signal they want in normal operation. This normal operation usually includes square waves which means there are going to be harmonics, spikes and so forth.

While ICs seem to thrive on a diet of crud and garbage like that, the rest of the world is not so tolerant. It would seem prudent to try to remove as much of it as possible from the nearby environment.

Shielding and bypassing should be employed as a matter of course to help keep this stuff from getting to the

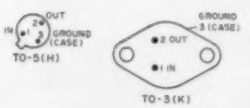

Fig. 1. LM309H (K) 5 volt regulator.

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Denville NJ 07834

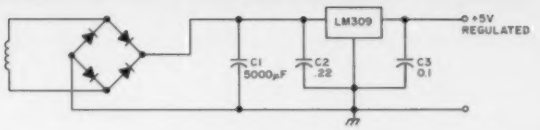


Fig. 2.

outside world.

The regulator bypass capacitors will not only help to protect it from itself and the rest of the circuit, but will help keep down the amount of damage that can be caused to other equipment from interference.

While the regulator can be located any reasonable distance from the supply, care should be taken with the placement of these capacitors.

While most of the IC parts values appear to have quite a bit of leeway, these appear to be specific values and should not be skimped on.

As with any bypass capacitor, locate them as close as possible to the regulator itself and keep the leads as short as possible.

While these two will handle the bulk of the jobs you will have to do with digital IC power supplies, there are many projects that will require a wider range of voltages.

Most of this can be handled by the LM340K or the LM340T positive voltage regulator series. Fig. 3 shows the pin configuration of the two and the chart of available output voltages.

The basic difference between the two is the package. The LM340T is in the T0-220 transistor package and the LM340K is in the T0-3 transistor package.

Either model will handle an Ampere of current output with care. Fig. 4 shows how this regulator hooks into the main circuit.

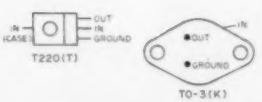


Fig. 5. LM320T(K) negative voltage regulator. LM320T(K) (5.0, 5.2, 6.0, 8.0, 12, 15, 18 or 24).

As the schematic shows, the same values are used for the bypass capacitors with this IC as with the LM309 series regulators.

The same precautions should be taken with the placement and the lead length – as close and as short leads as possible.

Fig. 5 shows the negative version of the LM340. This is the LM320T(K). Notice that there is almost the same range of voltages available. Also notice that the pin configuration is slightly different. This is important.

The negative input is also connected to the case which can then be connected to chassis ground, thus keeping chassis ground at negative potential if desired.

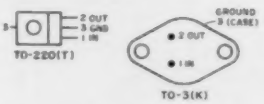
Notice in Fig. 6 that there is a ground symbol used rather than the familiar chassis ground. This is confusing as it is not the old meaning which was literally an earth ground, as opposed to the chassis common point which may or may not have also been grounded.

Here what is intended is the circuit common point, and not necessarily a connection to either the metal chassis or to an earth ground.

With solid state work there is often the problem that the circuit common connection can be either plus or minus and may not necessarily be either chassis ground or earth ground, and either plus or minus potential may be connected to the chassis or ground independently of the circuit common connection.

It makes for quite a few possible combinations which must be carefully watched for in the circuit. ICs are usually more straightforward in this respect than transistors.

Fig. 3. LM340T(K) regulator. Code number includes voltage. LM340T (or K)-(5.0, 6.0, 8.0, 12, 15, 18 or 24).



There is one big difference in the circuit which is immediately apparent in the schematic (Fig. 6). This is the value of the bypass capacitors.

They are ten times bigger than those for the positive regulators. Also they are rather specific about the type of capacitor that is to be used. They should be solid tantalum. Those are the minimum values that should be used. They can be higher if convenient.

About now panic is starting to set in as you try and figure out where to get solid tantalum capacitors. No, you don't have to try a midnight raid on Cape Kennedy. These are a fairly common surplus item. Usually the same catalogs that have the ICs you want will also list the solid tantalum capacitors you need to go with them.

While there are applications where you might want to build a negative regulated supply by itself, most of the time working with a separate supply you have only to switch the leads to do the job. This circuit was shown to simplify a larger supply.

There is one area where you will certainly want this type of negative supply. This is when you get into working with the IC op amps or other ICs which require a dual polarity supply.

These ICs make it very simple to get your plus and minus supply. All you have to do is put a negative and a positive supply back to back and you have it made.

This is shown in Fig. 7. As can be seen, this is virtually the same circuit as the two individual supplies, but now they are both together. The only thing that has been added is two diodes.

For this type of supply you just choose two regulators with the same output voltage, whatever is desired. These two were intended for just this type of service.

The diodes are a protective device to let the regulators start up looking into a common load. They may also serve the purpose of preventing a wrong polarity voltage from getting from one regulator into the other.

Notice that they are reverse polarity to the supply each is across and would block the voltage from the other where a load resistor would not.

The diodes are rated at the regulator short circuit current rating. For 12 and 15 volt dual supply (one Amp), a 1N4720 is listed. For a 15 volt 200 mA supply, a 1N4001 is listed.

That is the overall survey of the basic type of supply you will be working with. While there are far more complex configurations to handle extreme situations, these will serve for almost anything you might want to try.

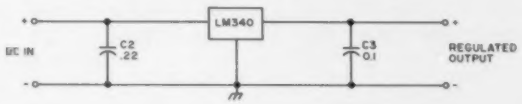


Fig. 4.

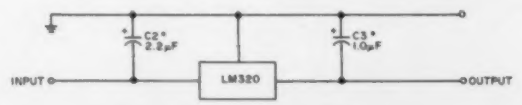


*Fig. 6. *C2, C3 – solid tantalum.*

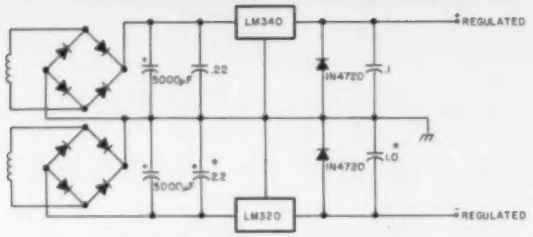


*Fig. 7. Dual polarity supply. *Solid tantalum.*

Within the range of simple variations on the basic design, you will be able to get even more practical advantage. However, before getting into variations, a few words are in order on the preservation of these devices.

While they are quite rugged when used as intended, as all transistorized equipment, they are quite intolerant of any mistakes you might make.

The easiest mistake to make is with the internal device dissipation. Most of these regulators will accept a voltage input of up to 35 volts and still give the required voltage output, but there is a built-in booby trap.

Assume that you want five volts for a digital circuit and have available a twenty-four volt supply. You could simply add the regulator circuit as shown in the drawing and you would get the five volts output, up to a point.

Under a light load, you would probably be OK, but when you started to draw much current, good-bye IC. This is the internal rating problem.

Assume that you want to draw one full Ampere of current through this regulator. With five volts out and an input of twenty-four volts, you are left with nineteen volts to deal with.

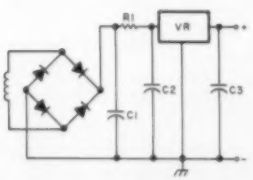


Fig. 8.

At one Ampere through the regulator, that means almost twenty Watts has to be accounted for. It helps to remember that this is a regulator, not a power resistor, and should not be used as one.

Some of these regulators can go a little over their ratings and may be more forgiving with the use of the proper heat sinks, but there comes a point where you have troubles.

Most of the regulators such as the LM309 series are built with an internal shut down feature for when the going gets hot, but even then you don't have to go asking for trouble.

There is one very simple way to deal with this particular problem. Use a dropping resistor. This is shown in Fig. 8. The value is quite easy to figure once you know what you are looking for.

Most of these regulators are designed to operate with anything from one volt over their rated output voltage up to their limit. To leave some margin, figure on a two volt margin.

In the example shown, the output is to be five volts and the input is twenty-four volts. The desired input is seven volts, two more than the device output. Assume that the maximum current of one Ampere is to be drawn.

This means that the resistor must drop seventeen volts. This works out to a seventeen Ohm resistor. If you want to be very safe, use a 20 Ohm resistor.

The power involved is seventeen Watts. Use a twenty Watt resistor at the minimum. Most of the time for experimental work you will not be drawing the full output, but it's nice to be prepared.

While this might be an extreme example, it is within the range of what might be encountered when you are working with what you have on hand. It points out your most effective rule of thumb.

If you want to have the maximum reliability of the circuitry when you are experimenting or designing, stay as far within the ratings as you possibly can.

The simplest thing to do is to start with the voltage you plan to use as the input source and then figure what the full load current and power would be through the regulator. As long as it is within the device's ratings, you would be safe.

It would be better to use the resistor as a matter of course, figuring it as in the example for two volts more than the output of the regulator.

This is based on a steady supply voltage. If the supply voltage drops under load, you may have to determine the resistor value experimentally for the correct input to the regulator. You should have some margin to work with above the two volts you are aiming for.

In this case you want to make sure that under full load you get the required input to the regulator. Under light load a higher input can be tolerated because it will not be dissipating much power.

Once you have the safety requirements for these regulators in mind and know how to work within them, there are several tough dog problems which have surprisingly simple solutions.

The first, and most obvious problem, is what to do when you need to supply more than one Ampere of current. This doesn't often come up with experimental circuits, but does with a lot of finished equipment.

The technical type answer to a problem like this would be to use an external pass transistor with the regulators as the controlling element. The transistor can handle the extra current, but it makes for a more complicated circuit.

There is an easy way out. Use more than one IC regulator. Split up the load among several so that no one has more than it can handle. This is shown in Fig. 9, and is quite a common feature of many circuits. It also provides better decoupling between different parts of the equipment.

When you are working with experimental circuits it would be nice to have a variety of voltages available. A multi-output supply is a formidable undertaking ... or is it?

That same technique can be used to provide a number of standard output voltages. Fig. 10 shows the basic schematic. The resistance values can be figured the same way as in the example already given.

One thing to keep in mind is that the total output current is limited by the output current available from the basic supply. Thus if the supply can only handle three Amps, then you cannot draw more than that in total through the combined regula-

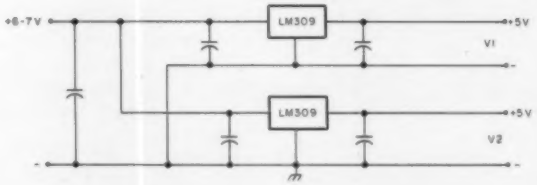


Fig. 9.

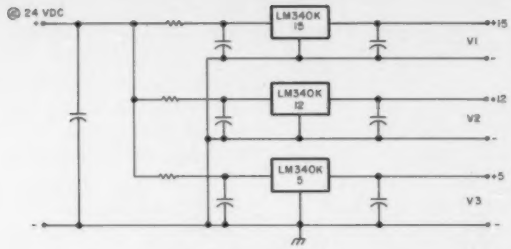


Fig. 10.

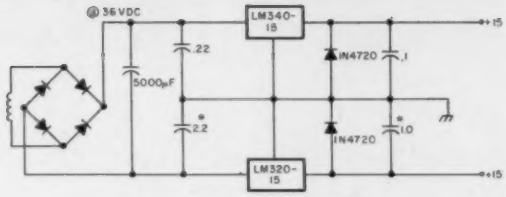


*Fig. 11. *Solid tantalum.*

tors.

Fig. 11 shows an oddball circuit that I was told would work with a single supply. It does not look like something for the faint of heart.

It might work, but it breaks the rules about not pushing the ratings. While normal operation would divide the voltage between the two so that each was only getting a few volts more than needed for operation, if one regulator were to short, it might throw the full voltage to the other regulator.

As this is on the dangerous side of the ratings, it might damage the other regulator too. It doesn't cost that much to play it safe.

That should handle just about any of the usual experimental or finished equipment regulated supplies you might need for most of your work.

These devices are probably the most commonly available on the surplus market, but there are many more that also can be used. Some are intended for more precise uses or other applications, but most can be used just the same way that the ones mentioned can.

A quick look shows that the external parts used are often the same values as given for the devices described.

This sort of information is usually supplied with the application notes for the IC. It would pay to get the application notes for any new type you were not already familiar with.

The IC and solid state field is constantly changing. By the time this is in print there may be a whole new line of goodies available to the experimenter on the surplus market.

There are a number of small regulators that will supply standard voltages at one or two hundred mils. These were intended for on-board use in sections of equipment and cost less than a buck each.

One item that is expensive now, but may come down, is the three terminal high current regulator capable of five Amperes of current or so.

Looking at the ads, there seem to be a number of small kits of parts and built modules that will supply sufficient voltage and current for both digital IC and op amp type ICs for a price close to what the parts would cost. They should be kept in mind as a quick and easy way into the game.

If you stick to the simple, available and cheap for a while and remember not to push the ratings, it will be hard to go wrong. ■

LETTERS

from page 26

one and one half year YASME DXpedition. They operated as VR1Z, VR8B, 3D2KG, C21NI, FKØKG and YJ8KG. (All QSLs via YASME, P.O. Box 2025, Castro Valley CA 94546.)

Iris recently applied to the FCC for a two letter call of her choice, under the new rule for Extra class holder with more than 25 years experience. Iris's first choice was W6QL (W6QL was formerly held by Jim Wells, a famous DXer, now a silent key). So it is now Lloyd, "W6 King George" and Iris, "W6 Queen Lady."

Iris and Lloyd hope to renew their "Worldwide YASME DXpedition" again to some different parts of the world in a few months.

Lloyd Colvin W6KG
Iris Colvin W6QL
Castro Valley CA

YOUR OWN LEXICON

May I suggest that somewhere in *73* you provide a column similar to the *QST* "Hints and Kinks" column but geared specifically to "computronics," i.e., the computer end of ham radio. Oftentimes there are little tidbits that we come across while putting together a computer system that can be of great help to others who may end up experiencing the same difficulty. Such little trivia as taking Elmer's glue and tacking each of the 48 fiber washers to the Imsai 22 slot mother board can save hours of time in trying to align each to its respective hole and also insure that there will be no shorts to chassis. Such helpful hints would not warrant a full length article and yet they are important. To further illustrate, if one wanted to purchase the IMSAI UCR1 cassette I/O board, it would be nice to know that this board is not a "connect the plugs and start recording" device. Rather, the board requires an extensive program to be entered, which takes about one hour on the keyboard and about three hours loading from the front panel. So unless one is prepared to buy an additional ROM or PROM board, there will be lots of loading to do each time it is to be used. On the other hand, the National Multiplex Corporation "CC7" data recorder will work as a stand-alone device. And, too, it will interface with current ham RTTY gear such as a model 28 or a deluxe Hal Ds-3000. We also have this recorder.

Ten months and almost $2,700 dollars later we have set up a very nice fully operating computer system. We have experienced the good and the bad. Generally the good has been Hal Communications, Godbout, etc. The bad has been in large measure due to ignorance, but also to a reluctance on the part of some companies to share with you all the pertinent information. Some companies such as Godbout and Hal will go out of their way to be helpful and specific. Others (nameless) will not do so, which puts one in a precarious position if he knows not what to ask.

Perhaps you could call the column Byte Bugs, Ins and Outs, Bug Bits or just plain Bugs. Or you could do like Shakespeare and create your own lexicon. Give it some thought, Wayne. There are a lot of fellow hams out there who are itching to jump into computronics and whose only reluctance appears to be a lack of knowledge. Certainly, one can hold the cost below that of a good transceiver and still have a fine computer controlled station that will also play Star Trek with the kids. I know, with the Hal Ds-3000 2.x tied into the company IBM-370, the IMSAI 8080 with lots of memory and a host of I/O cards and keyboards, I could provide lots of helpful hints.

Nenad S. Downing WB4SLO
Chattanooga TN

Anyone for Ins & Outs? — Wayne.

NUTS?

I've been in Taiwan, a police state incorrectly described as "an outpost of freedom," for a year. I read and speak Chinese so they don't fool me (and I've got an MA in studying them). You cannot believe how fortunate we Americans are — no secret police, no political slogans on TV, radio, and painted on every wall, a *free* press, policemen who help, not spy, and on and on and on. Of course there is no ham radio here, save for a couple of showcases in Taipei.

Add my compliments to S&D Sales. I ordered one of their cheap clocks. It arrived ten days after I mailed my order and works perfectly. Also got similar service on a CPO ordered from Heath.

Also pass on my compliments to the folks at *73*. I sent in an order for books and tapes and got them in three weeks! You folks must be nuts. Things don't work like that.

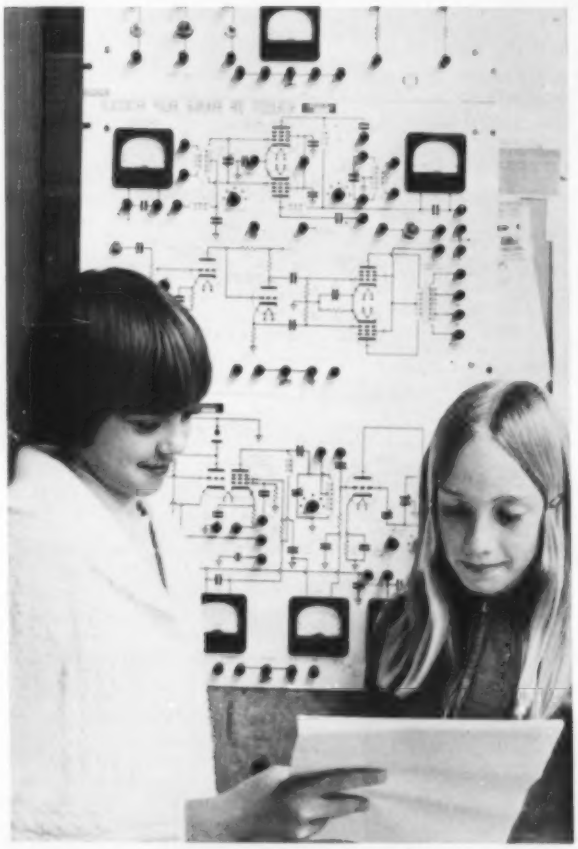
Joseph A. Schlatter, Jr. K4FPT
APO San Francisco CA

Don Inman
350 Nelson Rd.
Scotts Valley CA 95066

Hamming 101

-- another Cabrillo College pioneering program

Recently, I sat in on two sessions of a Cabrillo College summer school CW group. Cabrillo is a community college located in Aptos CA. The CW group is a part of ET 80AB, Special Projects in Electronics, which gives an opportunity for students to explore electronics areas of special interest on an independent study or seminar basis. Forty students are enrolled in the course; twenty-six of these are in the CW group.



Girls participate in class, too.

Eddy Pollock, Director of Technical and Vocational Education, acts as the ringmaster for this three ring circus composed of beginners, advanced, and super students. The beginners group, at present, has ten members receiving and sending at 0 to 4 wpm. The advanced group has twelve working at 6 to over 14 wpm. The super group has four members qualifying at over 16 wpm. The goal of each student is to improve his code speed at least one word per minute per week.

Eddy keeps all three groups going at the same time in adjoining rooms. A normal classroom serves as a place for instruction and code practice. Enrollees take turns on the key so that both receiving and sending practice are provided. An adjoining room houses WB6JOD, the Cabrillo amateur station. Here is where the real action takes place. All groups have a chance to get in on "live" communications at the station as well as "canned" tape programs.

No doubt some *73* readers are aware of, or have communicated with, WB6JOD or its predecessor, WA6TST. Eddy established WA6TST when he came to Cabrillo in 1960. In 1962 Cabrillo moved to its permanent and present location and was assigned the call letters WB6JOD. The station is a part of the Electronics Technology Communications Laboratory, as well as serving as the Tri-C (Cabrillo College Communications) Electronics Club station.

Mr. Pollock, a charter member of the Institute of Amateur Radio and a lifetime subscriber to *73 Magazine*, is an inspiration to past and present Cabrillo electronics students. Well over two hundred students have obtained amateur radio licenses as a result of his efforts with the Tri-C Club. The club holds practice sessions at noon during the regular school year and in the evenings during the summer. Tri-C has scored high or won several DX and Field Day contests.

WB6JOD is a busy station with many users. It operates up to 30 hours some weeks, the total time depending upon the number of personnel available for supervision. Contacts have been made with approximately 150 foreign countries and all states in this country.

Licensed personnel attached to Cabrillo include: Eddy Pollock W6KHS, First Class Radio Telephone Engineer, Amateur Extra Class, and Citizens Band; Dr. Larry Edler WB6MVK, Extra Class; Jim Marshall WA6HCL, Advanced Class; George Jurichovich K6PPZ, General Class; Royce Krilanovich K6QJZ, Advanced Class, Adult Evening Program teacher; Mary Duffield WA6KFA, General Class, Electronics for Young People teacher.

During the 1976-77 school year Cabrillo will add specific seminars for radio. ET 84AB will prepare students for an Advanced Class FCC license, and ET 84CD offers preparation for the Extra Class FCC license.

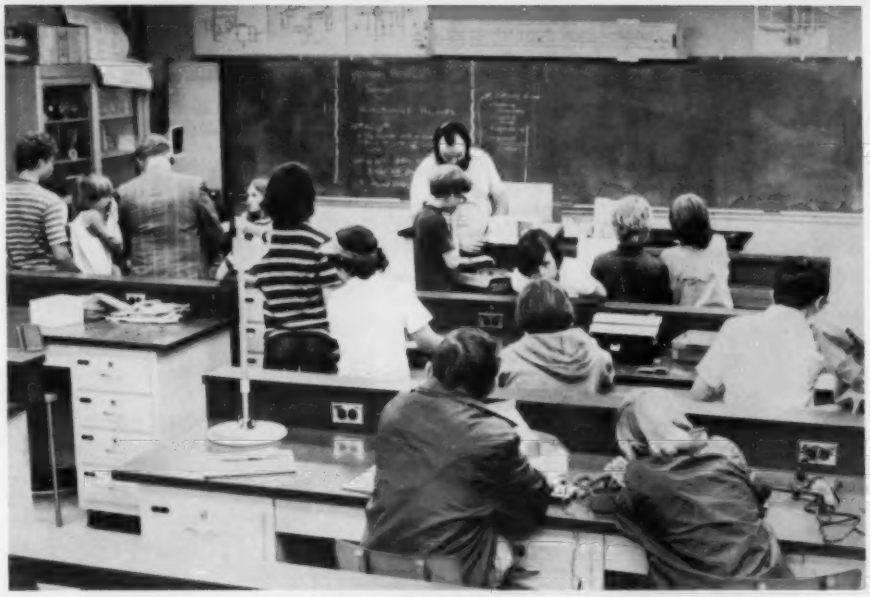
All age groups and both sexes were represented in the CW class this summer. Intense interest was highly evident in the class as members offered

constructive criticism and encouragement to each other's efforts. This attitude seems to pervade the amateur hobby groups with which I have come in contact.

Community colleges, such as Cabrillo, help to fill a vacuum that is being created in our public secondary school systems. As school financing gets more critical, special interest classes such as radio, computer programming, and other electronics courses are in trouble. As schools become more crowded, the administration begins to examine the smaller classes for possible elimination. A teacher is thus freed to take the overload. By their very nature, laboratory classes are usually small due to equipment and safety factors. Therefore, they become the prime target for elimination. New courses being suggested in the rapidly expanding computer field are failing to get off the ground for the same reasons.

Many of us in the education field feel that these classes are important – even more important than some of the traditional classes which are "required" courses for all students. We must find ways to provide this kind of knowledge to our young people. It is in this area that community services offered by such community colleges as Cabrillo prove so valuable.

Another aspect of Cabrillo's Community Services was opened to me recently. My 12 year old son participated this past year in two electronics courses offered to youngsters. One striking feature observed was the creation of a soft-sell technique for education. Public school teachers, as well as parents, could learn something from this approach. No pressure for grades and no fact-memorization to pass tests were evident. Each session was a fun-filled and information-packed experience. From the surprise gift package of electronic components, which opened the first meeting, to the drawing for electronics books, which closed the final meeting, the course provided something for every participant.



Class members of "Young People's Seminar in Electronic Projects" at work.

This first course entitled "Electronics for Young People" was limited to 10-14 year olds. While the instructor introduced electronics fundamentals, the students were able to examine, feel and ask questions about the components under discussion. Color codes, component units, values, etc., were tied into the physical components in a meaningful way. A code oscillator, a frequency counter, a two meter transceiver and other electronic "goodies" received lots of attention during the break of the three hour sessions.

During the second session of this course, my son and I contributed a computer demonstration. An Altair 8800 with 1K of memory, operating in machine language, was used. This equipment is part of a system being built up by the Mountain Digital Group, a small local organization dedicated to providing the schools with an introduction to computers and computer programming.

While a brief description of the computer's operation was being given, Kurt programmed the computer. He loaded a few number guessing games for the students to play. (For those of you with new computer equipment but no input/output devices – take heart. There are a number of interesting things you can do through the front panel switches with only a small amount of memory.) In Kurt's first number guessing game, a correct guess triggered a music program and "Daisy" was played over a nearby radio. A guess too high turned on all the data lights, and a guess too low turned off all the data lights. The kids really went for this game. There were many "Far out!", "How neat", and "Ah" and "Oh" remarks from the young audience.

A visit to Cabrillo's amateur radio station highlighted the final meeting of the class. On one wall was a world map with a pin for each foreign contact made by the station. QSL cards were posted alongside from many stations. Eddy Pollock fired up the transmitter, and each student was allowed to speak into the "live" mike. It was several minutes before each student had sent the sounds of his voice over the airwaves. Eddy then spoke a few words into the microphone, and suddenly the students were confronted by the sound of their own voices coming back over the receiver. It seemed that Eddy's father, Earle WA6OSQ, another ham, had recorded the students' transmission and was now playing it back from his own transmitter. The students also visited the Radio and TV Lab of the college during this session.

During class breaks and at other times, Mary Duffield WA6KFA, the instructor of "Electronics for Young People," tuned in her transceiver to one of the amateur bands. While students gathered around, Mary explained how to get a ham license and encouraged all to take a crack at it.

Mary recently retired from 33 years in the public schools. Owner of a 35 foot sailing vessel, Mary was drawn to the field of radio communications out of necessity. Cabrillo provided her with the opportunity to learn electronics, and she now holds a General Class license. She has become so enthused over amateur radio that she is now thoroughly involved in

Members of Tri-C Electronics Club at the Novice station.

passing along her new-found knowledge to youngsters. As I write this, Mary is out at sea with a group of young people. They are involved in UNESCO work, contacting other young people from other countries. They're making friends via radio communications and face-to-face contact. Her summer experience should be a story unto itself.

Eddy Pollock is the real mover behind these courses for youngsters. He set up and taught the original course in 1971 at the urging of Community Services. Twelve students showed up for the original offering, and classes have been full ever since. Over four hundred children have poured through Cabrillo's doors to take part in this one course.

A natural follow-up to this introductory class was one called "Electronic Construction" taught by Eddy himself. This class opens with a quick review of the previous course. The students were then given a handful of components and a printed circuit board in order to learn and practice soldering techniques. Enough college students, who volunteered as lab assistants, were provided for almost a one-to-one ratio of supervisors to students. Recognition of components, their characteristics, and methods of mounting on printed circuit boards were demonstrated and practiced. Correct usage of hand tools, with particular stress on safety, was brought into play.

Students were allowed to select their projects from a suggested list for group purchase or to select one of their own choosing from some other source. Quite a variety of projects were chosen, including code oscillators, battery checkers, walkie-talkie AM radios, three-band radios, strobe lights, a parabolic microphone, and an infrared burglar alarm.

At the second session, all kits had arrived. An air of anxious anticipation filled the room. Before construction began, the students checked their parts lists for any omissions or incorrect parts. They were then on their own to construct their kits from the assembly manuals furnished. There was much excitement evident as boxes and plastic bags full of components were opened and examined.

"Is this a capacitor?"

"What is this?"

"Look at your parts list."

"Which resistor is the 1k?"

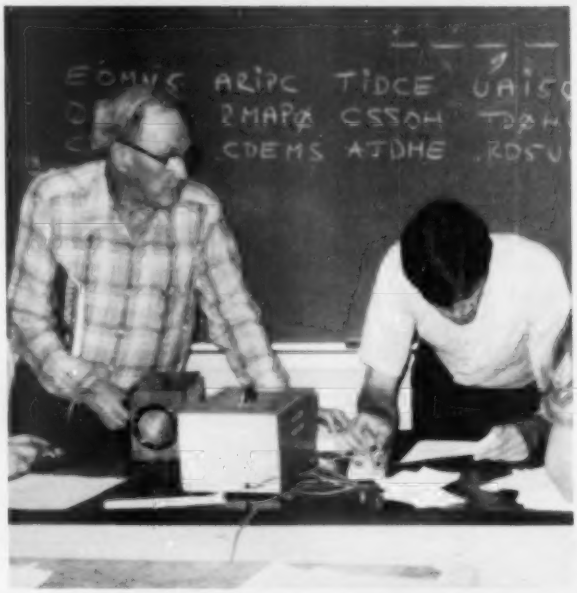
"Look at your color code."

Questions flew faster than the assistants could respond, at first. What an ideal learning environment! Then the class settled down to a semi-quiet concentration as parts began to be put into their proper places.

Two class meetings were largely devoted to actual construction of the projects. Lab assistants provided advice and aid when troublesome areas were encountered. Test instruments were provided to check out the projects at various stages of completion. Happiness and satisfaction glowed in the young faces as projects checked as desired. If the results were not satisfactory, a grim determination to find the cause and set things right was seen.

At the fourth, and final, meeting, the students were allowed some time to put final touches to their project. The projects were then arranged in groups, according to the age of the builders. Each student then inspected each project and cast a vote for the best constructed project in each age group. Students voted for the best overall project, also. Each winner received a prize, either an amateur radio book or a project construction book. The grand prize winner received a walkie-talkie construction project as well.

The future of amateur radio and other hobby groups seems secure as long as people like Mary Duffield and Eddy



Code practice even during break at 1976 summer Special Projects class at Cabrillo.

Pollock can be found. But, they need help. Look around your own community and see if such courses exist. If not, find out if facilities and personnel to start such courses can be found. Find the persons who are putting their hearts, as well as their energies, into providing for those children whose education is rapidly approaching a "no frills" condition. Give them some of your time and help if you can.

At the present time, most schools feel that they have neither the facilities nor the personnel to handle programs of this nature. They also have problems scheduling non-traditional courses in an overcrowded situation. It is my contention that provision should and must be made. Certain techniques of learning in a laboratory environment are vastly superior to the lecture-test methods of many traditional classrooms.

My particular field of interest is in computers, and I feel very disturbed in meeting strong resistance to the implementation of courses in this important and fast growing field. As a member of the Mountain Digital Group, it has been my privilege to present demonstrations in our local intermediate and high schools, as well as at Cabrillo College. We also presented a session at the California State Science Teachers Convention in an effort to interest teachers in computer kit-building classes. With the appearance of inexpensive kits spreading at a rapid pace, it is obvious that there is no reason a student should be denied access to a computer.

Projects carried out this past year in my own classroom have shown that high school students, with little electronics experience, are capable of putting together microprocessor kits. In addition, they acquire an amazing amount of electronic knowledge in an enjoyable, informal atmosphere. ■

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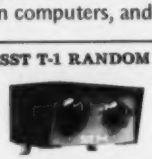

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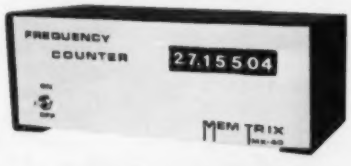

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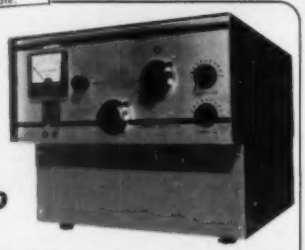

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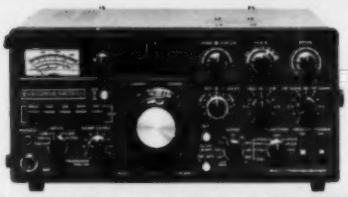

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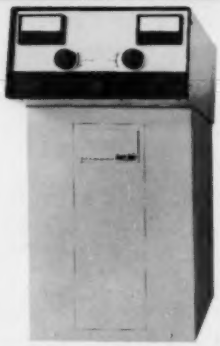

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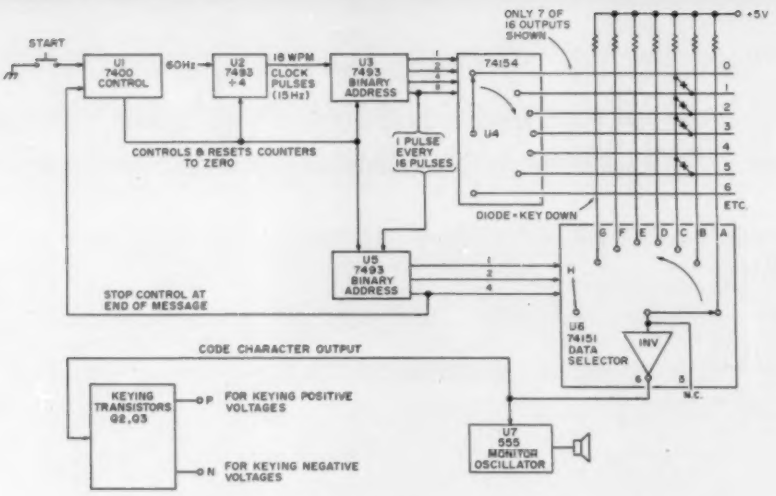

Fig. 1. Block diagram of CW IDer.

Bert Kelley K4EEU
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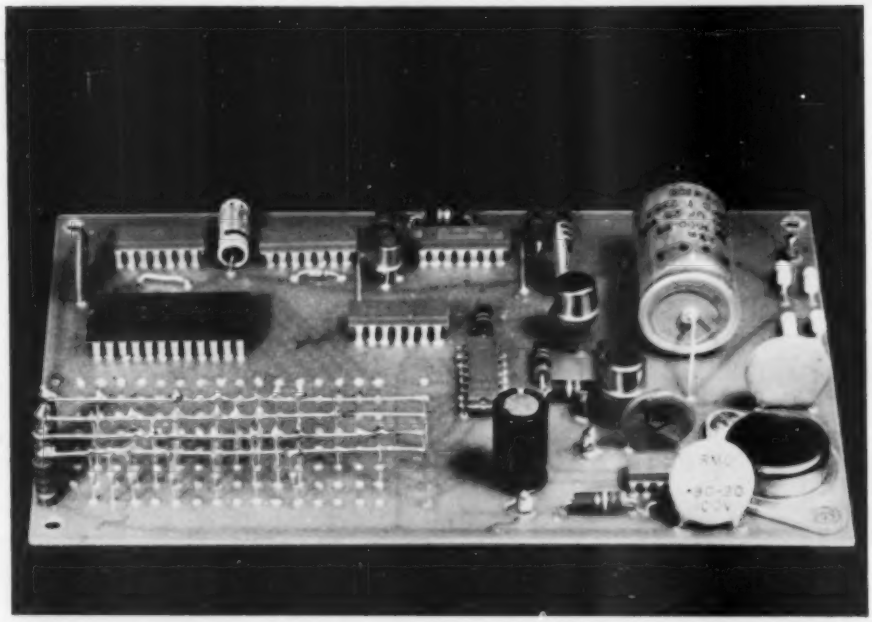
A Super Cheapo CW IDer

-- for FM repeaters and RTTY

This device automatically generates your call letters for the FCC required CW identification and can be started by either a push-button or a pulse from other equipment. If you have been hand sending CW or using a mechanical code wheel on RTTY, here is a way to improve operation at low cost. It also has an audio output that can be used as a monitor or to modulate FM repeaters.

The IDer is complete on a small 4" x 6" circuit board with built-in power supply, provision for either positive or negative voltage keying without relays, monitor, and an adequate 128-bit diode memory. Its simple design is its best feature because the TTL logic required is cheap and available. The diode memory is easily programmed or, if necessary, changed when needed. Contrast this with more sophisticated designs using programmable ROMs which must be programmed correctly the first time with no mistakes. The code speed is derived from the ac line for a fixed 18 wpm. This eliminates a few parts, and adjustment, but fully complies with regulation 97.87(h). Last, but equally important, a circuit board is available to help you in construction.

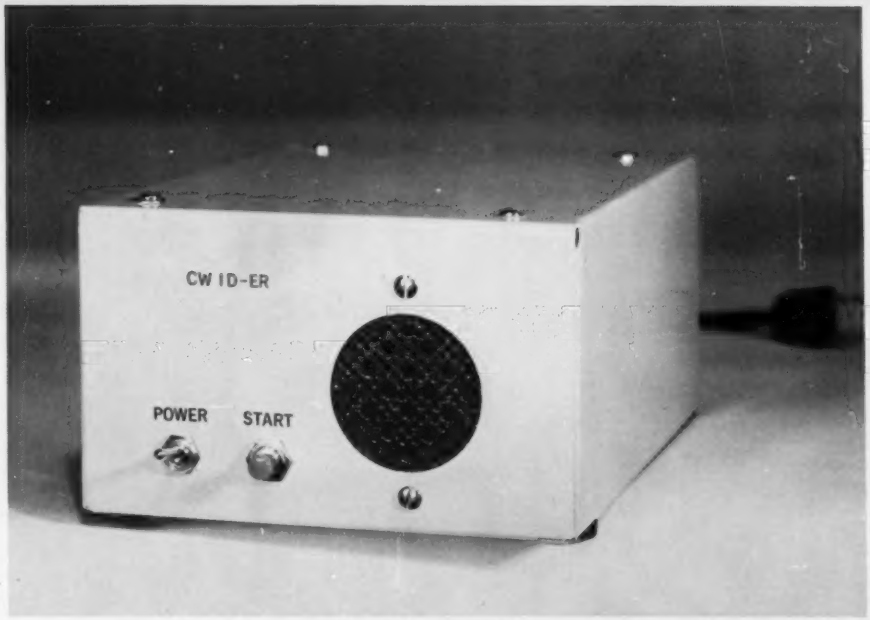


Side view of board showing construction of matrix.

Circuit

The block diagram (Fig. 1) shows the functions of the integrated circuits. U1 is a start/stop control and resets U2, U3 and U5 so they start each sequence from the same point. A push-button or pulse sets U1, the control line goes low, and U2 starts dividing 60 Hz pulses by four, driving U3. The BCD output of U3 determines the status of U4, a four line to sixteen line decoder/multiplexer – actually a sort of single pole, 16 position rotary switch. As U3 counts, U4 advances and grounds each of the sixteen outputs in sequence. In the meantime, U5 is counting each time U4 finishes a complete sweep, and with U6 is used to select the eight output lines A through H, so that only one is active for each sweep of U4. This multiplies the 16 position output of U4 by a factor of eight, giving a matrix with a 128 position or "bit" capacity. When U6 has completed its sequence, U5 generates a pulse which automatically resets U1, and concludes the transmission.

The eight input lines to U6 are pulled to a logic one by 2200 Ohm resistors mounted vertically on the circuit board. The inverted output of U6 then remains low and the keying transistors are inactive unless the scanning sequence is started and reaches points in the matrix where diodes are connected. They allow U4 to ground inputs of U6 without short-circuiting all the connections together. If we assume the IDer is at rest, pin 1 of U4 is grounded, and the input line A of U6 is positive via the 2200 Ohm resistor. Since this is the at rest or starting point, no output is wanted and therefore this position has been omitted from the circuit board layout. When the button is pressed, the matrix is scanned from the resting point A0 through A1, A2, etc., to A15, then B0, B1, B2, etc., until operation concludes at H15. Viewing the trail side of the circuit board, it is in reverse to the way you read a paragraph in a magazine. The schematic (Fig. 2) shows an example of the IDer as programmed for "DE K4EEU."



Front view of CW IDer.

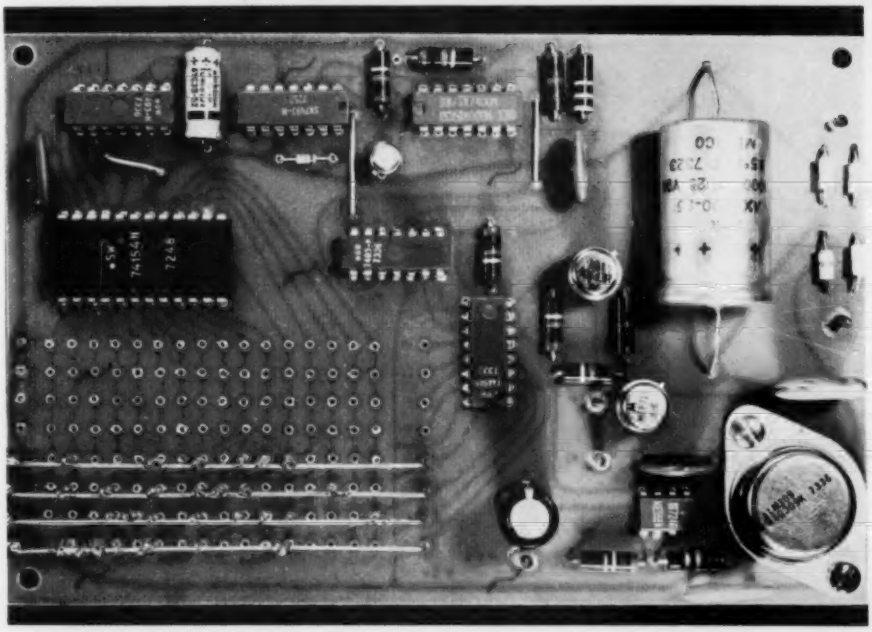
Q2 and Q3 are high voltage keying transistors. If you are keying a positive voltage, only Q2 is installed. For negative keying, add Q3 and a 1k base resistor as shown. Naturally, Q2 can be used to operate a relay if you want to key an isolated voltage in a B plus line, for example.

Monitor

The 555 timer makes a simple and effective monitor. The frequency will be about 800 Hz with components shown, a square wave which is more than adequate to drive a small speaker directly. The tone is all right for monitoring but may be cleaned up with a simple low pass filter.

Parts and Construction

A circuit board layout is given in Fig. 3 for those who want to make their own. An epoxy, undrilled, but plated circuit board with parts list is



All parts mounted on board. Note ample reserve space in diode matrix.

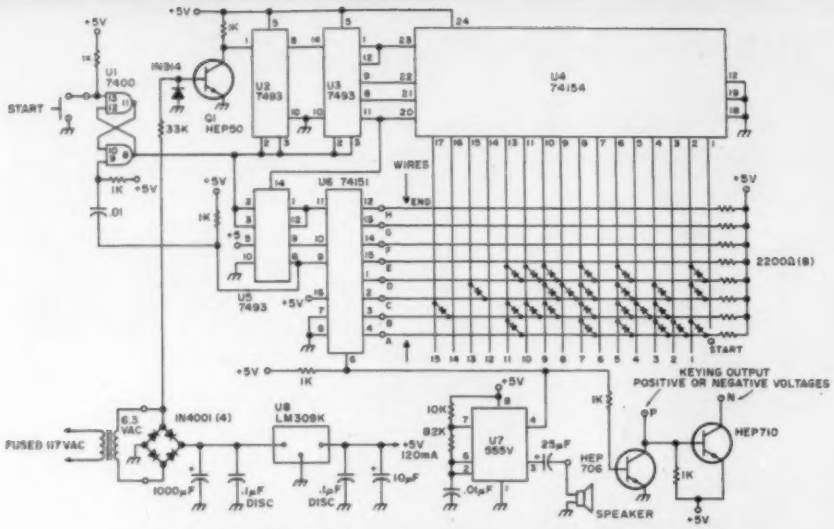


Fig. 2. Schematic of CW IDer programmed for "DE K4EEU."

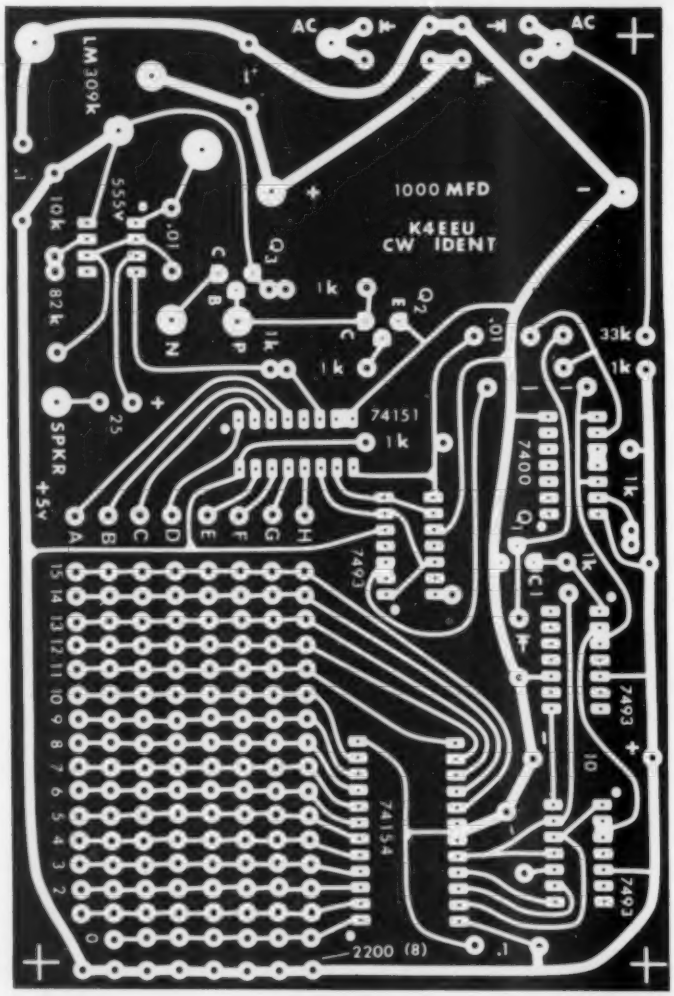


Fig. 3. PC board.

available from me for $8 postpaid US and Canada only. Parts locations are screened on the board to make construction fast and easy.

The HEP transistors are shown because they are stocked by many local parts houses as universal replacements. RCA has a similar line and SK-3018, SK-3103, and SK-3025 may be substituted for Q1, Q2 and Q3. The remaining parts are sold by advertisers in this magazine.

Note that the mounting screws on the LM309K regulator are also circuit connections, and verify that the regulator output is 5 V within a few tenths of a volt. Diodes may be either silicon or germanium, but should be checked on an ohmmeter. They are mounted vertically with cathode band toward the circuit board.

The speaker impedance is not critical. Once the holes are drilled with a #60 drill all parts can be mounted on the circuit board and the unit bench-tested in about one hour. The completed device can be installed in a small 5" x 7" x 3" chassis or mounted in vacant space in other equipment such as a RTTY demodulator.

Programming

This is done by installing diodes at locations where a tone is wanted on the matrix according to the following rules: The first bit, A0, is reserved for standby. A dash is three bits, or three diodes in a row; a dot is one bit, or one diode; a space is one bit, or no diode. Three vacant spaces between characters, and seven bits or vacant spaces between words. An L-shaped bus is formed of stiff plated wire and connected above the board between each A, B, C, D, E, F, G, H input of U6 and supported at the other end above the board by the vertical 2200 Ohm resistor. The anodes of the vertically mounted diodes are soldered to these buses. ■

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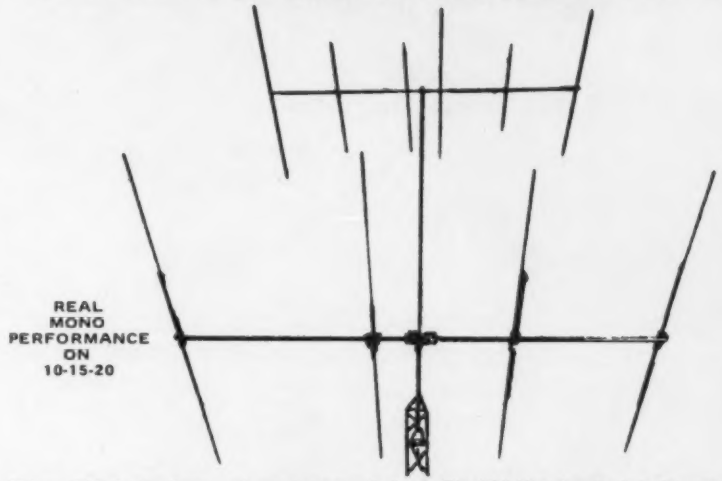
WILSON 204 MONOBANDER PLUS DB33



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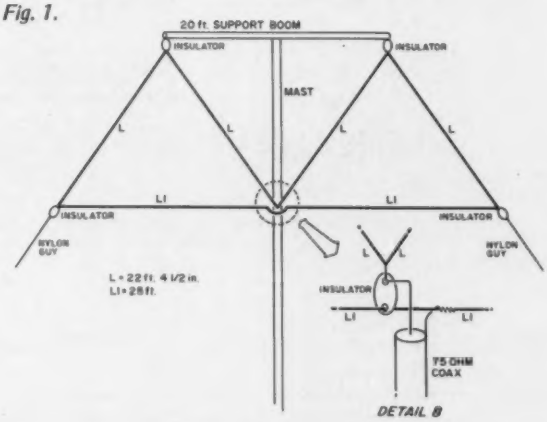
On 10, 15, and 20 meters, 75 Ohm coax cable provides a good match; however, on 40 and 80 meters a transmatch is recommended.

The antenna I am presently using has 4 elements at right angles to each other, with all the vertical elements connected to the center conductor of the coax and all the horizontal portions connected to the braid. Needless to say, the results have been fantastic on all bands. ■

Fig. 1.



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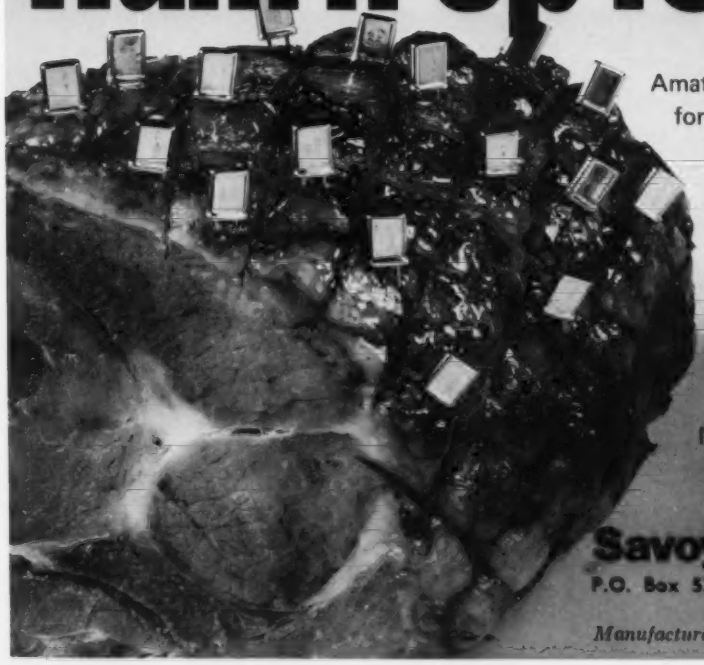

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CT7001 Clockbuster

-- the ultimate clock/calendar (for now)

For several months, I have been toying with the idea of building a digital clock using one of the many integrated circuits that are out on the market today (see the ads in this magazine). A recent sale on the Cal-Tex CT7001 clock-on-a-chip integrated circuit was too much to resist. I quickly ordered one along with six readouts and was soon on my way to constructing a digital clock. The results of using the CT7001 have exceeded my expectations, and this article is an attempt to provide you with sufficient information to build your own.

The CT7001 has many features which may be selected according to how the various scanned inputs are connected to the digit output pins. The chip is also available in either seven segment outputs (CT7001) or BCD outputs (CT7002).

General Description

Fig. 1 is a block diagram of the integrated circuit and external connections. All that is necessary to make use of the integrated circuit is a power supply, 4 or 6 readouts, and the external switching matrix which will be described in complete detail later in the article. The integrated circuit makes use of a 60 Hz timebase frequency from the power line to count the hours, minutes and seconds. There are also provisions for battery backup should the power line fail, and the integrated circuit has its own internal oscillator to take over the 60 Hz timebase. The actual frequency is determined by the RC circuit connected to pins 25 and 26 of the integrated circuit. There are no particularly critical parts of the external circuitry with the exception that you should use an integrated circuit socket rather than soldering the IC directly into the circuit. The reason for this is that the MOS type circuit is sensitive to static electricity which could destroy some of its inputs.

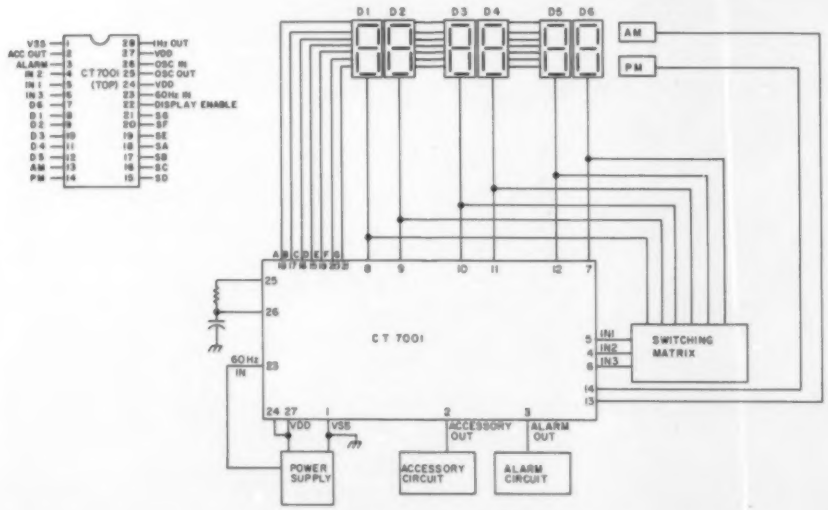


Fig. 1. Block diagram of CT7001.

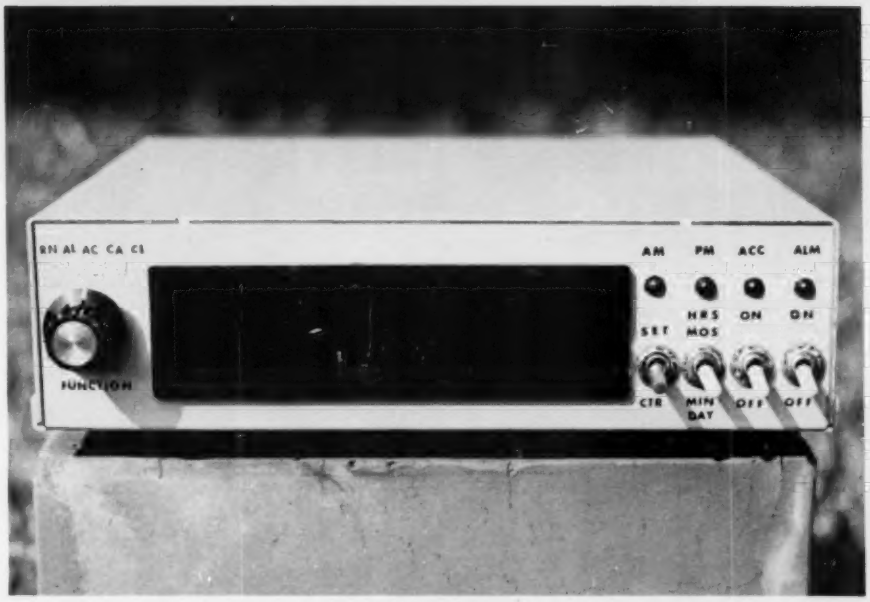
The particular mode of operation is determined by connecting various digit outputs to the three scanned inputs of IN1, 2 and 3. The chip was designed so that setting any one particular counter such as the time, alarm, calendar, etc., is possible without upsetting or affecting the contents of any other counter.

Since there are so many options available with the CT7001, I have not made this a detailed construction article, but rather a description of how to apply the CT7001 and by so doing, allow you to choose the options you desire in constructing the digital clock. This way, it will be possible to tailor the external circuits according to your own individual requirements.

The integrated circuit will accommodate 4 to 6 seven segment displays as shown on the block diagram. It will direct drive luminescent anode display tubes, and the application brochure from the manufacturer states that it will direct drive common cathode LEDs. However, one word of caution is in order. It will

direct drive common cathode LEDs as long as the segment current does not exceed five milliamps. If your particular LED will draw more than five milliamps per segment, it will be necessary for you to incorporate either the transistor driver or integrated circuit driver that will be described later in the article.

To summarize, the CT7001 incorporates a 28/30/31 day calendar, 12/24 hour clock operation with true 24 hour alarm setting, snooze alarm, 50 or 60 Hz timebase, 6 digit direct drive display, clock radio features, on chip 60 Hz backup oscillator and easily settable counters which will be explained in the following section.



Front view.

Operational Modes and Switching Matrix

Referring to Fig. 2, we have a chart showing the scanned input options which are available with the clock. The first input is IN1 and by connecting various digit output pins to this IN1, the operational mode of the clock will be changed accordingly. Likewise, the same holds true for inputs IN2 and IN3.

For example, there are three display modes available, depending on the connection of IN3 to either D3 or D4. With no connections to the C1 or C2 inputs, the time will be displayed for eight seconds and the calendar for two seconds. If the C2 input is closed (D4 to IN3), only the calendar will be displayed on a continuous basis. Likewise, if the C1 input is closed (D3 to IN3), only the time will be displayed on a continuous basis. The am and pm outputs will operate during the clock and alarm display modes when the clock is operating on a 12 hour basis. If it is switched over to a 24 hour clock, the am and pm outputs will not be available.

This means that if the 12/24 hour input is closed (D2 to IN3), the clock will operate on a 24 hour basis (00:00:00 to 23:59:59). Should the 12/24 hour input be opened, the clock will display 12 hours with an am and pm indication both on the clock display and the alarm.

If the alarm switch is turned on (D1 to IN3), the alarm output will go high when the clock counter is coincident with the preset alarm counter. The alarm output will remain high until it is terminated by opening the alarm switch.

While the alarm is functioning, if the snooze switch is closed momentarily (D6 to IN2), the alarm will be disabled for ten minutes and this cycle can be repeated as many times as desired until the alarm is disabled by opening the alarm switch.

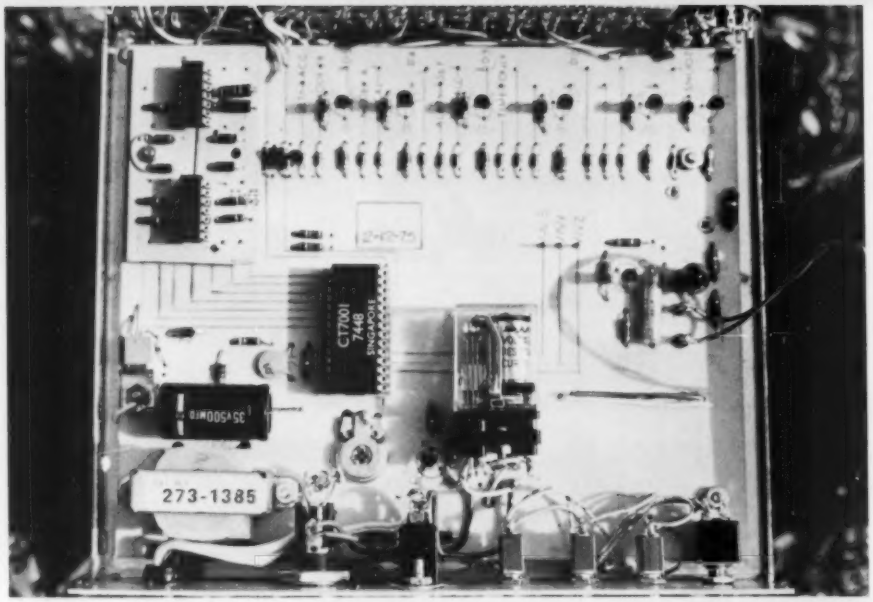
There is also a counter built into the clock chip that can be set in one minute increments from 9 hours and 59 minutes to 1 minute. This feature can be used to control some external appliance and may be utilized in three different ways depending on the setting of the Mode A and Mode B switches.

When Modes A and B are off, the accessory output will then be high for the preset time by closing the accessory switch, and this timed cycle can be interrupted at any time by opening the switch. When the accessory switch is closed again, the countdown will continue where it left off.

If Mode A is on and Mode B is off, the accessory will go high for the preset time period and also go high at the alarm time, providing the accessory switch is on. This mode may be used to turn a sleep/learning tape off automatically and then wake you up at the preset alarm time.

Input Pin	Scan Time	Input Name	Definition, Connection	Definition, No Connection
IN1	D1	Set	Set Counter	
IN1	D2	Set H/M	Set Hour or Month Digit	Set Minute or Day Digit
IN1	D3	Clock Radio Switch	Clock Radio Switch - On	Clock Radio Switch - Off
IN1	D4	Mode A	Mode A - Off	Mode A - On
IN1	D5	Mode B	Mode B - On	Mode B - Off
IN1	D6	50/60 Hz	50 Hz Input	60 Hz Input
IN2	D1	Set Calendar	Set Calendar Counter	
IN2	D2	Set Clock	Set Clock Counter	
IN2	D3	Set Alarm	Set Alarm Counter	
IN2	D5	Set Clock Radio	Set Clock Radio Counter	
IN2	D6	Snooze Switch	Snooze Switch - On	Snooze Switch - Off
IN3	D1	Alarm Switch	Alarm Switch - On	Alarm Switch - Off
IN3	D2	12/24 Hour	24-Hour Operation	12-Hour Operation
IN3	D3	C1	See note below	See note below
IN3	D4	C2	See note below	See note below

Fig. 2. Scanned Input Options. There are three display modes: (1) If the C1 and C2 inputs are left unconnected, time will be displayed for 8 seconds and the calendar displayed for 2 seconds; (2) If the C1 input is closed (C2 open), the time will be displayed on a continuous basis; (3) If the C2 input is closed (C1 open), the calendar will be displayed continuously.



The third possibility is to have both Mode A and B turned on with the accessory switch on. This will allow the accessory output to go high for the preset time *only* at the alarm time. This function may be used to turn an external appliance on for a certain length of time at any desired time. The individual counters are very easy to set with this particular integrated circuit and the procedure is as follows:

The counter to be set is selected by closing the set calendar clock alarm or accessory switch, which is accomplished by connecting either D1, D2, D3 or D5 respectively to the IN2 input. Then, if D2 is connected to IN1, the hours or month digit will be advanced. Or if D2 is not connected to IN1, the minute or day digit will be set. Once this is determined, connecting D1 to IN1 advances the digits of that particular counter at the rate of one digit per second. During the set clock function, connecting D1 to IN1 also sets the seconds to zero and freezes this particular register until the clock is started again. This allows you to set the time say one minute ahead of WWV time, wait for the tone, then switch the function switch to run at the right moment. With this feature, it's a cinch to synchronize the clock with WWV.

The calendar display for this particular integrated circuit is very unique. It has an internal memory which can determine which months have 28, 30 or 31 days. It will count the correct number of days for each month and advance to the next month at the end of the last day of the previous month. The only day which has to be manually set is February 29. This means that once the calendar is set, it will only have to be reset once every leap year on February 29. When I think of all the times I have had to manually reset the calendar on my calendar watch, this one feature is well worth the price of the chip.

Typical Circuits

Now to discuss some actual circuits you can use to build a digital clock. It is possible to incorporate either common cathode or common anode LEDs in the display. As mentioned previously, direct driving of the LED segments can only be used if the particular LED that you are using is a common cathode with a current draw of five milliamps per segment or less. Figs. 3 and 4 show a typical application for transistor driving common cathode and common anode LEDs. Six digit driver tran-

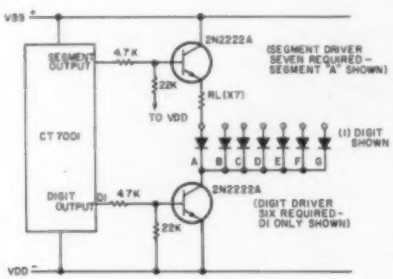


Fig. 3. LED interface for common cathode. RL is sized to limit current for specific LED used.

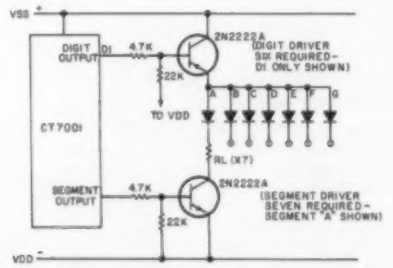


Fig. 4. LED interface for common anode. RL is sized to limit current for specific LED used.

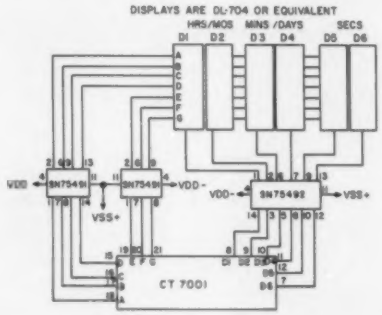


Fig. 5. Improved LED interface using SN75491 and SN75492 integrated circuits (for common cathode LED). SN75491 – quad segment driver; SN75492 – hex digit driver. Notes: (1) For both SN75491 segment drivers, pins 3, 5, 10 and 12 are connected to pin 11 through 150 Ohm ¼ W resistor. (2) Vss = 7½ to 9 V dc (10 V dc max).

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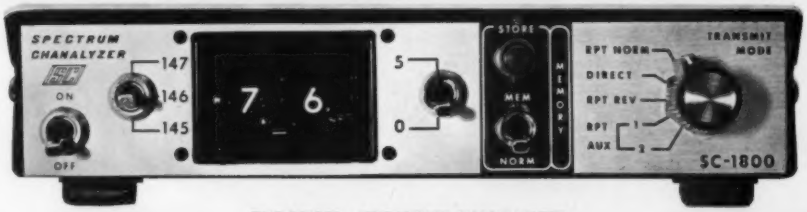

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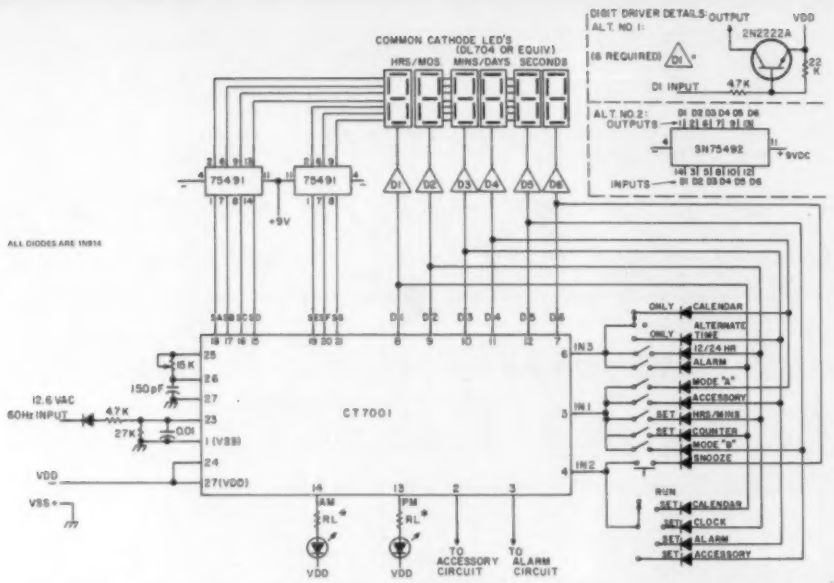
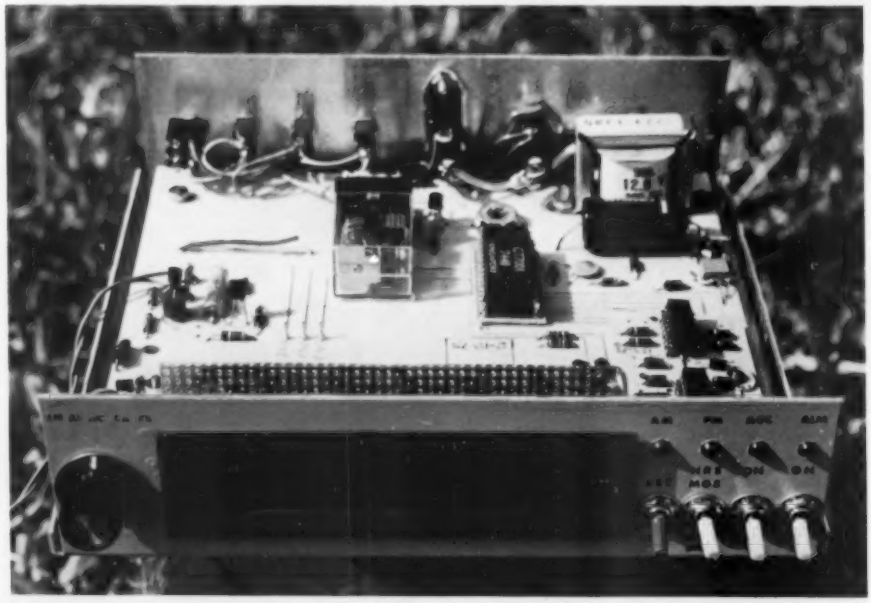


*Fig. 6. Typical clock circuit for common cathode readouts. Note: Each of the SN75491 segment drivers has pins 3, 5, 10 and 12 connected to pin 11 through a 150 Ohm ¼ W resistor. *Choose RL to limit LED current to less than 5 mA (typically 2.7k).*

sistors are required as well as seven individual segment drivers. Since the displays are multiplexed, all segments in the display are wired in parallel. This greatly reduces the number of drivers and load resistors that are required in a typical circuit.

It is also possible to use integrated circuit drivers for the digits, which greatly reduces the amount of external wiring. Fig. 5 indicates an improved LED interface using SN75491 and SN75492 integrated circuits. This diagram is for a common cathode installation. The SN75492 is a hex digit driver and the two SN75491s are quad segment drivers. For both of the SN75491 segment drivers, pins 3, 5, 10 and 12 are connected to pin 11 through a 150 Ohm, ¼ Watt resistor. The application sheet on both these integrated circuits indicated that the maximum supply voltage is ten volts and it is probably better to operate them between 7½ to 9 volts dc to avoid any damage to the integrated circuits.

In my particular clock, I had already etched the circuit board before I realized that it would be possible to use the improved interface integrated circuits. Consequently, my particular clock is a hybrid, using six transistor digit drivers and two SN75491 quad segment drivers as a typical application. This is shown in Fig. 6 and incidentally, this diagram is a typical application which allows you to incorporate all the functions that are available within the clock integrated circuit.



In order to keep the front panel of the clock as simple as possible, I located the display select, 12/24 hour, Mode A and Mode B switches on the rear apron of the clock. The set/function switch, the set counter, and the hours/minutes selector along with the accessory and alarm switches were located on the front panel of the clock. I used LEDs of different colors to indicate the am and pm settings of the clock and also an LED for each of the accessory and alarm switches to indicate when these switches were turned on. This feature helps to remind you to turn off the alarm or accessory when you don't want to be awakened early on a Saturday morning.

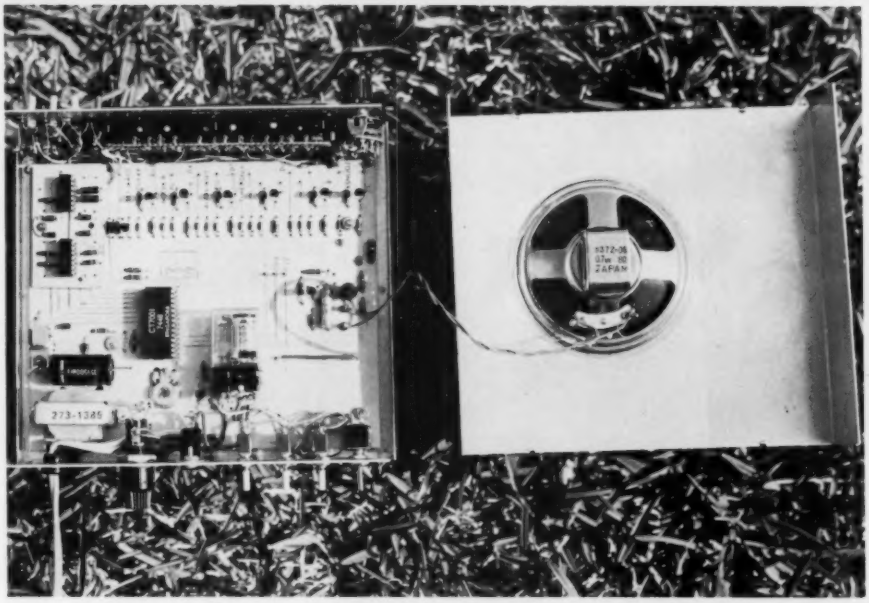
There are various options in regard to the alarm circuit, and Fig. 7 shows a typical alarm circuit using a transistor driver interface to turn on a programmable unijunction transistor oscillator driving an internal 8 Ohm speaker. A potentiometer can be incorporated into the circuit to vary the tone of the alarm output to suit your own particular preference. The output from this oscillator is sufficient to awaken all but the most ardent sleeper.

A friend of mine included another unijunction in his clock to produce an alarm similar to a police siren. However, the side effects the wavering alarm tone had on his wife prompted him to quickly change the circuit back to a steady, soothing tone.

A transistor driver circuit, similar to the one used to turn on the alarm, can be used to operate a 12 volt dc relay. The contacts from this

relay can be used to control some type of accessory function such as a clock radio, lamp or appliance. In my particular installation, I am using it to switch 120 volts ac to an accessory socket at the rear of the clock which is used to turn on a small radio. However, it can also be used to turn on some external appliance or other similar function. The circuit diagram is shown in Fig. 8.

Various power supply options are available depending on your own personal requirements and the amount of regulation that is desired. Fig. 9 shows a typical power supply with a PNP power transistor used to help regulate the output for the unit. Battery backup is provided by two nine volt batteries installed with a six volt zener diode. CR2 is installed to prevent the battery from supplying power to the displays when the normal power has failed. The battery is only used to operate the integrated circuit with its on-board oscillator to keep the clock functioning during a power failure. A variation to this circuit may be used to display the time for short periods to conserve battery power. Simply connect a momentary, N.O. SPST push-button switch across CR2. This will allow you to bypass the diode to display the time.



Top view, showing alarm speaker.

In some cases, it may be objectionable for the leading zero to be displayed during clock operation and also during calendar display. It is possible to blank the leading zero by means of a transistor and a few resistors. Since segment F is the only segment not required to form the digits one or two, it can be used to uniquely describe zero. If segment F is present during D1 time, the 2N2222A transistor will turn off the D1 to the display while preserving the D1 signal to the input matrix. Fig. 10 is taken from a Cal-Tex applica-

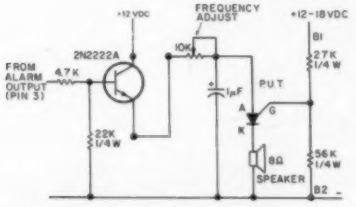


Fig. 7. PUT = programmable unijunction transistor (Radio Shack 276-119 or equivalent).

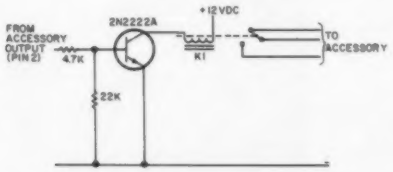


Fig. 8. K1 = 12 V dc coil relay suitable for switching accessory loads for miniature size.

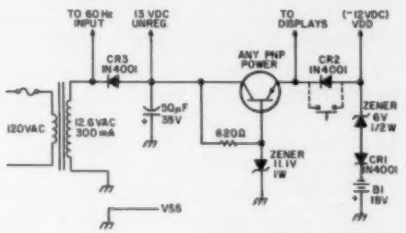


Fig. 9. Power supply for the CT7001 clock. During normal operation, all power is supplied from the ac power supply. During a power failure, the clock continues to operate from the battery backup composed of two 9 volt batteries. To limit current drain on the batteries, a diode blocks power to the displays. A push-button bypass switch across diode CR2 may be installed to momentarily view the display.

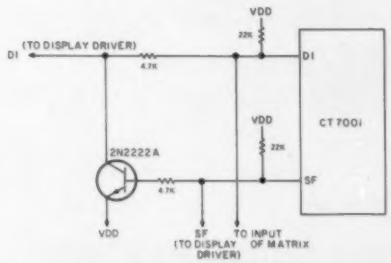
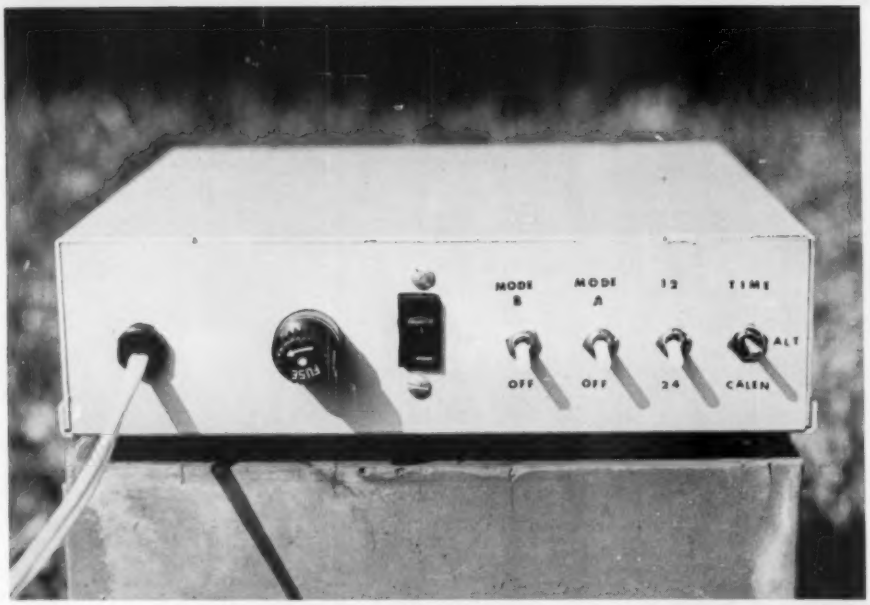


Fig. 10. Zero suppressing the D1 digit. Since segment F is the only segment not required to form digits 1 or 2, it can be used to uniquely describe 0. If segment F is present during D1 time, the 2N2222 A will turn off the D1 to the display, while preserving the D1 signal to the input matrix.



Rear view.

tion note on how the circuit should be connected to zero suppress the leading zero. Since I have not incorporated this feature in my particular clock, I can't vouch for the values of the resistors to be used, but I assume that they are the normal values that are used in the other driver transistor circuits. You might try a 4.7k resistor for the base and a 22k resistor for the bias resistor.

For those of you who desire more accuracy than the power line regulation, or for that matter, high accuracy when the power line fails, it is possible to incorporate a crystal oscillator as an external timebase. This is shown in Fig. 11 using a 100.800 kHz crystal with a one megohm resistor and a 5-50 pF variable capacitor. The frequency can be trimmed with the variable capacitor to result in a very stable external timebase whose accuracy is a function of the crystal used.

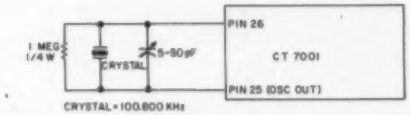


Fig. 11. External timebase. In this mode of operation, it is necessary to connect the 60 Hz input (pin 23) to Vss (Cal-Tex AN#107).

Conclusion

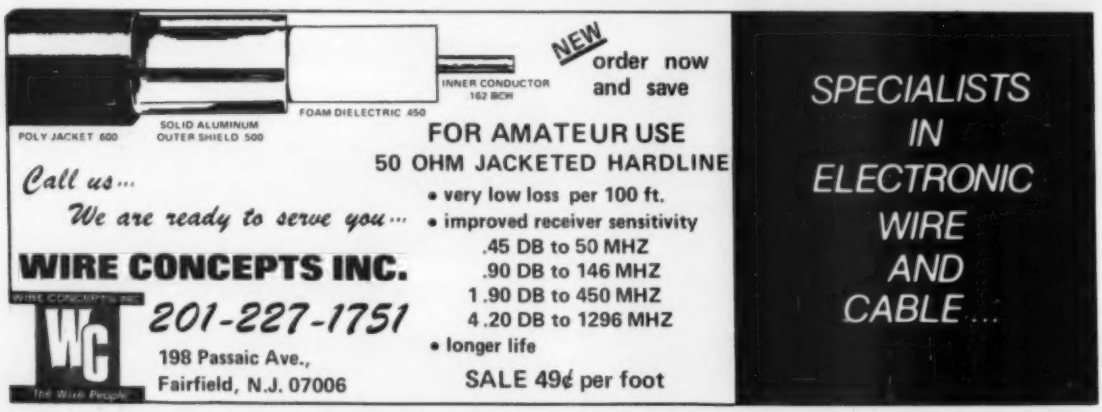
The clock has been in operation for several weeks now using only the timebase from the power line frequency to determine the accuracy of the clock. This timebase has proven to be adequate for most operations. In checking its accuracy in reference to WWV time signal, I have only noticed a few seconds variation over a couple of weeks. This high accuracy is due to the fact that the power line frequency is corrected from time to time so that its average deviation cancels out. As a result, the power line is a reliable source for a 60 Hz timebase, barring momentary power lapses. When this happens, the chip displays one more feature — at the moment power is restored, the clock begins counting, but displays all 8s. This is to let you know that the count is not accurate. By momentarily closing the set counter switch, the clock display will appear. Keep this in mind the first time your clock is turned on, as all 8s is a normal indication until the set counter switch is closed.

In closing, I highly recommend the CT7001 digital clock/calendar IC, and should you decide to build your own digital clock, it's a good idea to obtain the basic application notes from Cal-Tex Semiconductor along with the supplementary application notes listed in the references. ■

References

(1) *CT7001 Digital Clock/Calendar Circuit*, October, 1973.
(2) Supplementary information on CT7001 — dated January, 1975.
(3) AN#108 — Display oscillator.
(4) AN#103 — LED interface for common anode.
(5) AN#102 — Display options.
(6) AN#105 — Colon blanking during calendar.
(7) AN#107 — External timebase.

All references listed are available from: Cal-Tex Semiconductor, Inc., 3090 Alfred Street, Santa Clara CA 95050.



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Saving a CBer

--a new resource for hams

The harsh jangling of the phone grabbed me by the eardrums, and cruelly vibrated me awake. Slowly, groggily, I fumbled at the bedside phone, resolving to leave it off the hook the next Friday night. It seemed that I had just dropped off to sleep, and a quick look at the clock confirmed that impression; it was 9 am, and I had turned the rig off only three hours ago. Trying to work Australia with my minimal antenna system was as fruitless as hunting with a water pistol – all night and no luck.

The phone had reached my ear by now, and I mumbled something into the mouthpiece. "Good morning, Karl!" said an all too awake and cheerful voice. "I just passed my Advanced exam and I wanted you to know."

"Ken, are you kidding me? You just got your General three weeks ago!" Now completely awake, I found this news to be both amazing and just a little embarrassing – this kid had done in six months what had taken me three years to do.

"Well, Karl, I had a day off from school, and I have been studying for at least two weeks now, so I decided to give it a try." He decided to give it a try, I thought; no denying that the kid had plenty on the ball.

"Well that's just great, it's fantastic, actually. I gave you your Novice not more than six months ago. Congratulations! Not many hams can beat that; not bad for a converted CBer."

He signed off and I turned over in bed, not to sleep, but to think on his brief career in ham radio, which had been nothing short of astounding. I felt more than a little satisfaction and pride. He had done the work, of course, but I had been lucky enough to provide the proper guidance and to help send him on his way.

It had started one evening, while listening on the Chicken Band (our local nickname for CB). Amid the usual strange chit chat and madeup calls, something had aroused my interest. There, he was back again. "Yes, Little Chicken, and Red Hen, this is KBC 1234 (I can't remember the exact call). I was just saying that CB is OK for some things, but everything I've heard about ham radio makes me think that it's a lot more fun, and interesting too." I couldn't agree more, I thought; let's hear more. "All the things I've heard about it sound real neat, like talking to other countries, using Morse code – I still remember that from the Scouts – and even building or fixing your own gear. You can use hundreds of Watts and not worry about the FCC. It sounds like a great hobby, but it's hard to get started. I sure wish I had someone to help me out. It's like the difference between flying a kite and flying an airplane." Not a bad analysis, and he was right. CB does have its worthwhile uses, if the legitimate stations can get out from under the cacaphony of QRM from all those "Little Chickens" on the band.

I broke in, using W5EWF's CB call and rig (which I had been testing), and asked him to drop over to my shack that afternoon, to get that help he was looking for. Expressing surprise and thanks, the young man said his name was Ken and that he lived just around the corner from my house. That was my first and last CB contact, for that rig was sold the next day, W5EWF having despaired of the way the band had developed since its early days. That one contact made for a happy result, however: the addition of a bright, talented and very enthusiastic new ham to our fraternity.

Ken was right on time for our first meeting, and I quizzed him on his background, so I would know where to start. As it turned out, he had a good start, having retained all of his Boy Scout Morse code (at a speed of about two words a minute), and having studied basic electronics in high school. All he needed was exposure to actual ham radio, as well as guidance in his studies. He went off clutching copies of "How To Become A Radio Amateur" and "The Radio Amateur's License Manual," not to mention several copies of *73*. An hour of twenty meter phone seasoned with the forty meter Novice band had whetted his appetite.

Before I knew it, I was giving Ken his Novice test. Naturally, he was nervous, and he wrote hunched over the forms, in intense concentration. After it was over, I could not help but notice that the answers (which I had accidentally seen) were all correct. Although I reassured him, Ken was anxiously waiting for the mailman for the next month or so, calling me up every other day (after three weeks had gone by), wondering if such a long delay was normal.

Then one day, Ken came running up as I shoveled snow in my driveway. Giving the last shovelful a heave, I straightened up and greeted him.

"I made it!" he shouted. "I'm a Novice, I'm a ham!"

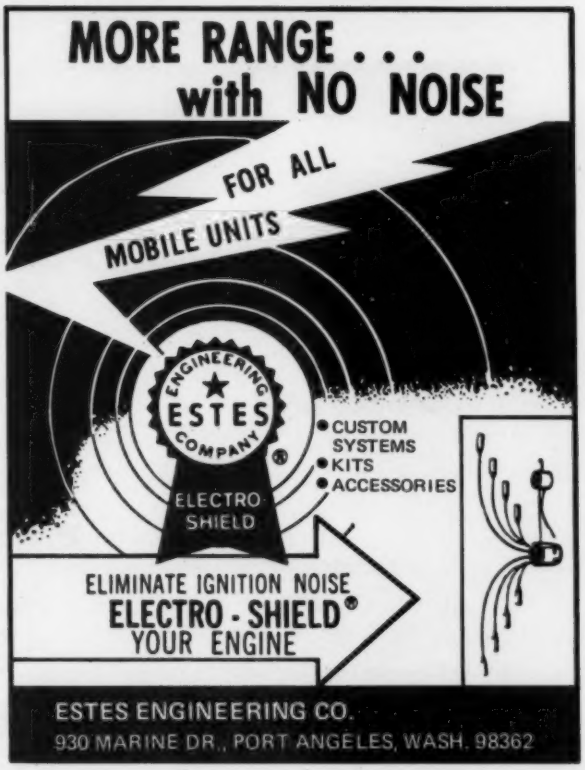
"That's great, Ken – but I knew you'd make it. What's your call?" I wondered how far down the list they had gotten.

"I'm WN9QDL!"

"Well, WN9QDL, why don't you hustle on over to your QRP Heath rig and I'll work you." Snow shoveling really never excited me that much anyway, I thought, as I headed for the shack.

One thing led to another, and one day about mid-April, the new Novice became a new Technician, and then (after borrowing some of my code tapes and a little technical advice on theory and its practical application), guess who was a General? I was only a little bit surprised at that, for Ken had been working hard. We put up some improved antennas and I loaned him my rig so he could try phone for a while, and got almost daily landline reports on how he was doing. It seemed to me that the thrill of being off the limited Novice bands would kind of slow down the climb up through the license grades, while he concentrated on making lots of contacts. Well, I was sure wrong on that score. His radio library had been steadily expanding to the point that I was sometimes borrowing books from him, and they were all well used when I received them – he had been studying.

So now Ken was an Advanced class ham. As I got dressed, I counted the months since he had received his first call – six months, to the day. Perhaps there were more good potential hams marking time on CB; a little encouragement might be all that would be needed to find them and bring them into the hobby. I resolved to listen in on 27 MHz some more. Just then, the telephone rang again, interrupting my thoughts. It was Ken again, asking to borrow my 21 wpm *73* code practice tape; he said he's just started working on his amateur Extra and his records only go to 18. Hmmm, I wonder if he can help me with my code – maybe I'll get that Extra class myself!■



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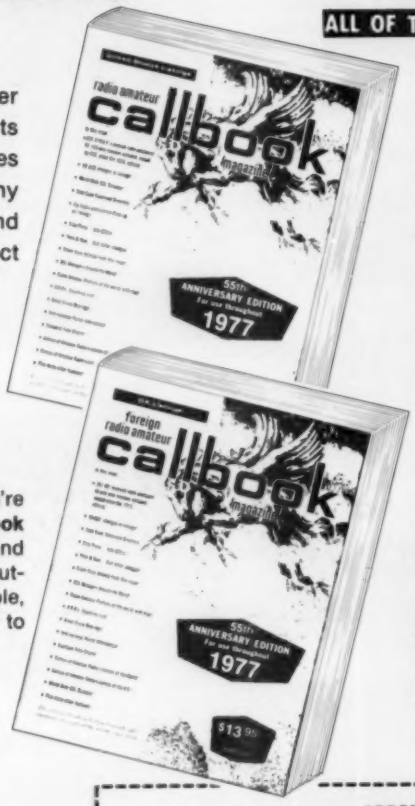

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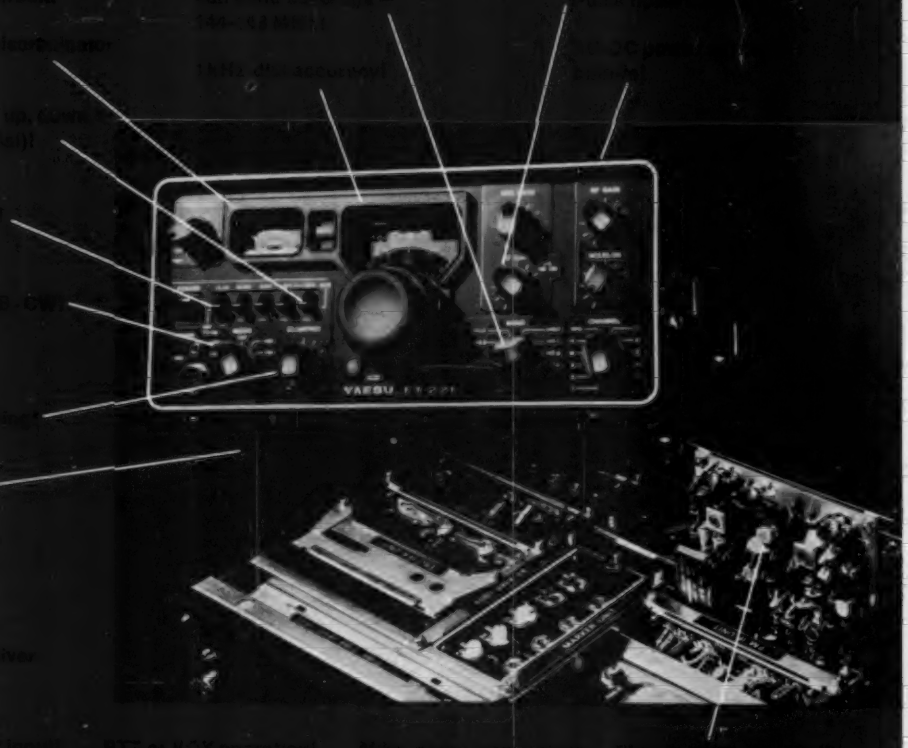

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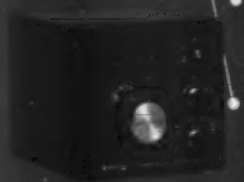

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FULL METERING • During receive, an easy to read meter functions as an S-meter. The same meter displays ALC level, plate current, RF output, and plate voltage during transmit. Includes COMP setting for adjusting the compression level of the built-in speech processor.

FINAL AMPLIFIER • The TS-820 is completely solid state except for the driver (12BY7A) and the final tubes. Rather than substitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky 8-2001A (equivalent to 8146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity. The input power of the TS-820 is conservatively rated at 160 W DC, 200 W PEP. Tubes run cool with the aid of a noiseless fan (standard) mounted on the rear panel. The above tube and power combination minimizes the possibilities of TVI and helps to maintain the Kenwood reputation for excellent audio quality.

DIGITAL READOUT DG-1 • (optional) A digital counter display can be employed as an integral part of the VFO readout system. Counter indicates the carrier, VFO, and first heterodyne frequencies to give exact frequency. Figures the frequency down to 10 Hz and digital display reads out in 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

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Dependable operation, superior specifications and excellent features make the R-300 an unexcelled value for the shortwave listener. It offers full band coverage with a frequency range of 170 KHz to 30.0 MHz • Receives AM, SSB and CW • Features large, easy to read drum dials with fast smooth dial action • Band spread is calibrated for the 10 foreign broadcast bands, easily tuned with the use of a built in 500 KHz calibrator • Automatic noise limiter • 3-way power supply system (AC/Batteries/External DC) . . . take it anyplace • Automatically switches to battery power in the event of AC power failure.

HS-4

The Kenwood HS-4 headphone set adds versatility to any Kenwood station. For extended periods of wear, the HS-4 is comfortably padded and is completely adjustable. The frequency response of the HS-4 is tailored specifically for amateur communication use. (300 to 3000 Hz, 8 ohms).

MC-50

The MC-50 dynamic microphone has been designed expressly for amateur radio operation as a splendid addition to any Kenwood shack. Complete with PTT and LOCK switches, and a microphone plug for instant hook-up to any Kenwood rig. Easily converted to high or low impedance. (600 or 50k ohm).

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KENWOOD

... the Pacesetter in Amateur Radio

TS-700A

Discover the luxury of 4 MHz

Kenwood's TS-700A offers the ultimate promise of 2-meters... more channels, more versatility, tunable VFO, SSB-CW... and Kenwood quality.

Operates all modes: SSB (upper & lower), FM, AM and CW • Completely solid state circuitry provides stable, long lasting, trouble-free operation • AC and DC capability (operate from your car, boat, or as a base station through its built-in power supply) • 4 MHz band coverage (144 to 148 MHz) • Automatically switches transmit frequency 600 KHz for repeater operation. Simply dial in your receive frequency and the radio does the rest... simplex repeater reverse • Or accomplish the same by plugging a single crystal into one of the 11 crystal positions for your favorite channel • Transmit/Receive capability on 44 channels with 11 crystals.

TR-7400A

NEW...AVAILABLE IN DECEMBER

KENWOOD'S EXCITING NEW 2-METER MOBILE TRANSCEIVER • All solid state • Synthesized phase lock loop (PLL) • Power output: 25 or 10 watts (high or low selectable) • 6 digit LED frequency dislay • Full coverage 144-148 MHz, 800 channels in 5 KHz steps • 600 KHz repeater offset • Continuous tone-coded squelch (CTCS) for transmit and receive or transmit only with tone elements optional • Tone burst (tone elements optional) • Kenwood dependability and value built in.

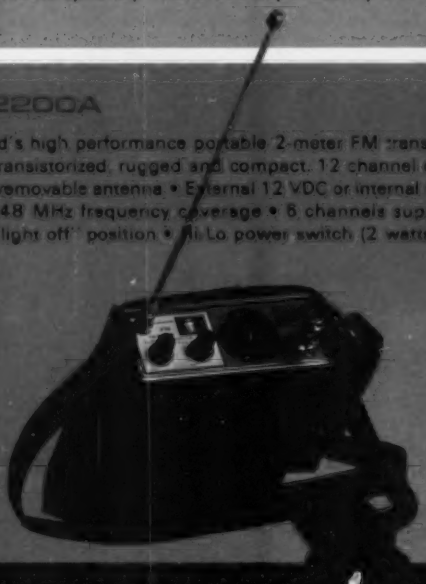
TR-7200A

Kenwood's superb 2-meter FM mobile trsnaceiver. Designed to withstand the most severe punishment while providing consistently excellent performance. Packed with features like the PRIORITY function... Put your favorite crystals in channel 7, and the 7200A switches there with the push of a button... no matter what channel you are on. 146-148 MHz coverage, 22 channels, 6 supplied. Completely solid state.

The perfect companion to the TR-7200A is the PS-8 AC/DC power supply. Together they provide an efficient and handsome base station. Complete with a digital clock and automatic time control feature built in.

TR-2200A

Kenwood's high performance portable 2-meter FM transceiver... completely transistorized, rugged and compact. 12 channel capacity. • Telescoping removable antenna • External 12 VDC or internal ni-cad batteries • 146-148 MHz frequency coverage • 6 channels supplied • Battery saving "light off" position • Hi-Lo power switch (2 watts-400mW)



I/O EDITORIAL

by Wayne Green W2NSD/1

ATLANTIC CITY!

The Trenton computerfest last spring was such a remarkable success that another computer convention in the same general area was organized ... this time by a group of three hams ... and in Atlantic City for the end of August. They named it Personal Computing '76.

PC-76 was a success by any measure. There were over 75 exhibitors and over 3000 attendees (at $5 to $7.50 per head). Judging from a show of hands at my talk (the room was jammed full and several hundred were turned away at the door), and from the number of people who came to the *73 Magazine/Kilobyte* booth, about one third of those present were hams. Since the computer hobby is duck soup for hams to get into, I suppose I shouldn't be all that surprised.

This was the first public announcement of the coming of *Kilobyte Magazine*, and I was most gratified by the enthusiasm. A very simple explanation of the need for *Kilobyte* was that I wanted a computer hobby magazine that *I* could understand. An awful lot of people agreed with me and signed up for subscriptions to *Kilobyte* ... about three times what we've ever done with *73* at any ham convention! More surprising was that 75% of them signed up for three year subscriptions ... and the first issue won't be out until December.

MITS was there with their latest equipment set up and running. A few of the firms didn't show up ... Imsai let their dealers do the showing ... Sphere had one dealer there with a unit. Quite a few new manufacturers of small computer systems showed up and won converts to their hardware. It was an exciting convention.

I got into my usual troubles. A few days before the convention I got a request from the group running it to tape the technical sessions. There were going to be as many as five going simultaneously and they couldn't handle it. Hmm ... I'd have to get some more cassette recorders and have at least five people there to make tapes ... plus a couple more to sell subscriptions at the booth. It would be expensive, but it would be good PR. A man in the booth would probably be able to sell an average of $600 per hour in subscriptions, and Big Bill Edwards, our advertising manager, sells about $20,000 per hour in advertising during a show like that.

The idea was for us to tape the talks and then make copies to be given to computer clubs for use during meetings ... and to sell additional copies of the tapes at $4, which wouldn't really pay for the effort, but would help take some of the sting out.

All went well for the first three hours ... then came the word ... no more taping. I gather that one of the computer hobby magazines made a big complaint about it and all of the money that *73* and *Kilobyte* would make out of the deal. I was angry ... and delighted. A lot of people and clubs would miss first rate talks as a result of the politics, and that was irritating. I was glad because it saved us an awful lot of work and expense ... probably for little return of any kind.

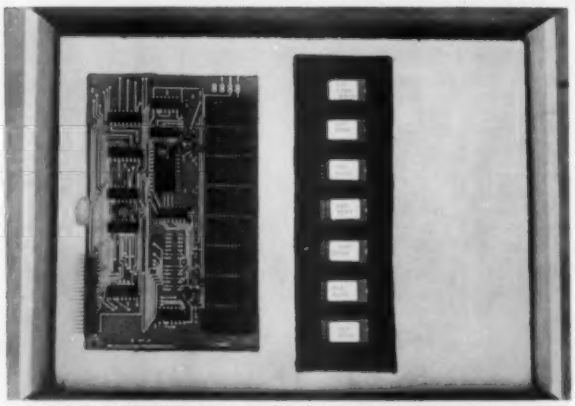
It was a pity, since *73* is so well set up to handle this type of thing. The tough part is having enough people to make the tapes ... and then editing them down a bit to fit a one hour cassette ... from there on it is easy ... except for the sales or distribution. This means letters to clubs, handling orders, keeping records. And the sales of cassettes means writing ads, having them set in type and published (a page ad in *73* is not cheap ... over $1000 these days), so anything advertised *has* to sell and sell well.

Last year at Dayton I tried to set it up so that we could tape the more interesting talks, only to have an RTTYer put in a very loud protest at "commercialism" ... he would tape for *free*. As far as I know he taped one lousy talk and very few people ever got a copy of it – while thousands of ham clubs were prevented by him from having very interesting material for meetings ... and the Dayton Hamvention missed out on a way to get fantastic publicity both via the audiences of thousands of clubs and via ads for the tapes in *73*.

A lot of people go to conventions in order to hear the talks, and a lot more would if they were exposed to more. And one of the most frustrating things at a convention is to have two sessions going on at the same time, neither of which can you bear to miss! I noticed that the Boston convention had their talks taped by a commercial outfit and the tapes were being made available for considerably more than *73* would charge. I do think the idea is a good one, but the cost should be kept down to ham levels and not just be a way for some commercial outfit to make a big killing.

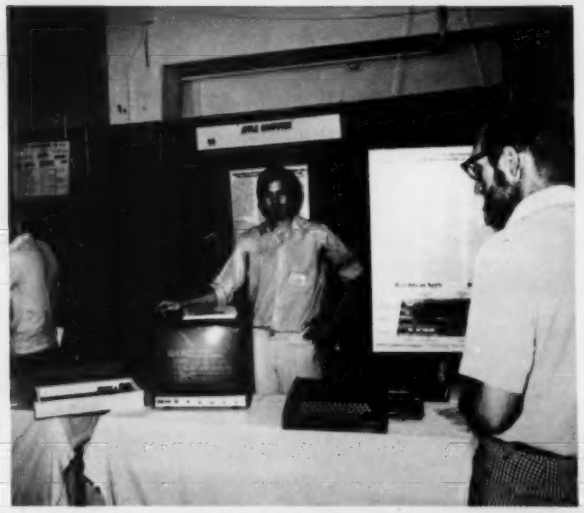
Outside of the taping brouhaha, the incredibly miserable hotel, the

***Here's the Apple** computer system up and running a game of Life. Note the tiny cassette I/O board at the right! This is a complete computer and video generator, all on one board. Any wonder there was a lot of interest in this system at PC-76?*



The Jolt 2K PROM board is shipped in a plastic foam package inside a carton, complete with detailed instructions. The PROMs are shipped mounted on conducting foam, to be plugged in after receipt. Jolt sells their boards in kit form or assembled. Their 1K assembler is supplied on four PROMs ... not a bad deal for under $100 including PROMs.

Jimmy Chiang checks out Sphere boards after final assembly and debugs them.



This is Steve Jobs, the president of Apple and the chap who designed the system. How many twenty year old computer designers do you know with their own manufacturing firms?

sauna-like atmosphere much of the time in the convention hall . . . it was a resounding success. Atlantic City is difficult to get to . . . too far from any large airport for many exhibitors (a great portion came in from California). The boardwalk and amusements were tacky, but if you have a chance to get into a penny arcade (they are 25¢ now) don't miss the computer games they have for you. You'll find yourself jumping around and screaming with delight at the tank game or the dogfight flying games. These are expensive, but worth it. We found one arcade where eight people could play at once, each driving his own tank and shooting at the other seven. The games are quite sophisticated, so be sure to give 'em a try the next time you see one.

These arcade games are just a hint of some of the goodies coming for home computer use. The new six game television toys are now on the market and are fun (under $60 some places . . . Unisonic), but they are simple compared to some of the microprocessor games that are coming. The arcade games use an F8 Fairchild microprocessor and are run by software. It won't be long before those programs are available for computer hobbyists.

I/O A WINNER

A large percentage of the hams at the Atlantic City computer convention and sauna said that the I/O articles in *73* had been their introduction to hobby computing. The fact is that aside from interesting the people already in the computer industry in going into their work as a hobby, there has been little effort so far to attract outsiders to hobby computing.

One big problem is that, other than the material in *73*, there has been practically nothing published which is understandable to the beginner. The series of articles which ran in *73* introducing newcomers to the world of computing have been gathered into a book called *Hobby Computers Are Here*. This is being sold through radio stores for $4.95 by *73 Magazine*.

The computer hobby magazines have gotten into the hands of people who are more interested in esoteric articles for professionals than in helping novices come up to speed in this difficult field. *Kilobyte Magazine* promises to help solve this impass by publishing a high percentage of articles written for the beginner . . . and further, there will be a glossary of the technical terms and buzzwords in each issue.

73 has so far withstood the temptation to try and promote the I/O section of the magazine to computer hobbyists. While this would make for better results for I/O advertisers, it might be somewhat detrimental to ham advertisers, since only about 25% of the computer hobbyists are into hamming so far. This may change. The current issue of *Computer Notes*, the official publication of MITS, has a lengthy editorial on the benefits of amateur radio for computerists . . . and president Ed Roberts is hard at work aiming at a General ticket as soon as possible. Perhaps the two fields will grow even closer together.

VISITING

During August I made a quick trip around the country to see how the hobby computer industry was doing . . . and to update myself on the similar trip I made the year before.

My first visit was to Ray Holt and the Jolt computer. This is an interesting development, and far too little has been written about it. Ray has agreed to explain some of the interesting ideas he has built into the system in an article for *Kilobyte*. I suspect that Ray would be a whole lot busier if more people understood what he has done with the Jolt.

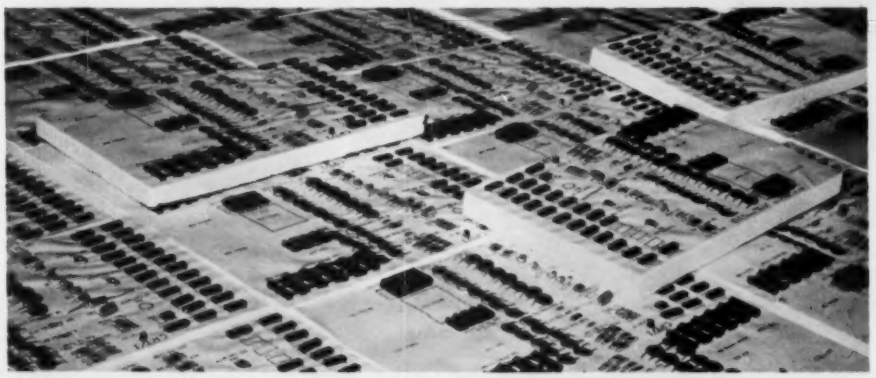
Next was a visit to Imsai. They'd just moved to a new and larger plant, but refused to let me see anything or take any pictures of the operation. That's the first time I've ever run tino anything like that and I didn't know what to make of it.

Apple Computer was a surprise . . . a corner of a garage in a home. Steve Jobs, twenty years old, designed and built the system with programming help from friend Steve Wosniak. He has some remarkably good ideas in the system and I was very impressed. I strongly suggested that they pack the system off to Atlantic City for the PC-76 show coming up. They did, and Steve came back with a bunch of orders and dealers (about 40 orders, I believe) . . . not bad! He's going to have his hands full as his company grows rapidly. Steve has promised an article on his design for *Kilobyte*.

Todd Anderson of Byte Shop #2 has promised an article on the Z-80 computer system the Byte Shops will be manufacturing soon. Todd is giving classes on the fundamentals of computers, and has promised articles for *Kilobyte* on the same subject.

One of the really exciting visits was with Bill Godbout in Oakland. He sells an incredible amount of ICs and associated parts. His warehouses are piled up to here with stuff . . . and any ham

Continued on page 173



Video generator board kits at Sphere awaiting delivery of a few more needed parts such as 7493 ICs. Parts are mounted on foam plastic with both parts numbers and values printed on a sheet on top of the foam. This makes it simple to find and use parts as the kit is assembled.

Imagine a microcomputer

Imagine a microcomputer with all the design savvy, ruggedness, and sophistication of the best minicomputers.

Imagine a microcomputer supported by dozens of interface, memory, and processor option boards. One that can be interfaced to an indefinite number of peripheral devices including dual floppy discs, CRT's, line printers, cassette recorders, video displays, paper tape readers, teleprinters, plotters, and custom devices.

Imagine a microcomputer supported by extensive software including Extended BASIC, Disk BASIC, DOS and a complete library of business, developmental, and industrial programs.

Imagine a microcomputer that will do everything a mini will do, only at a fraction of the cost.

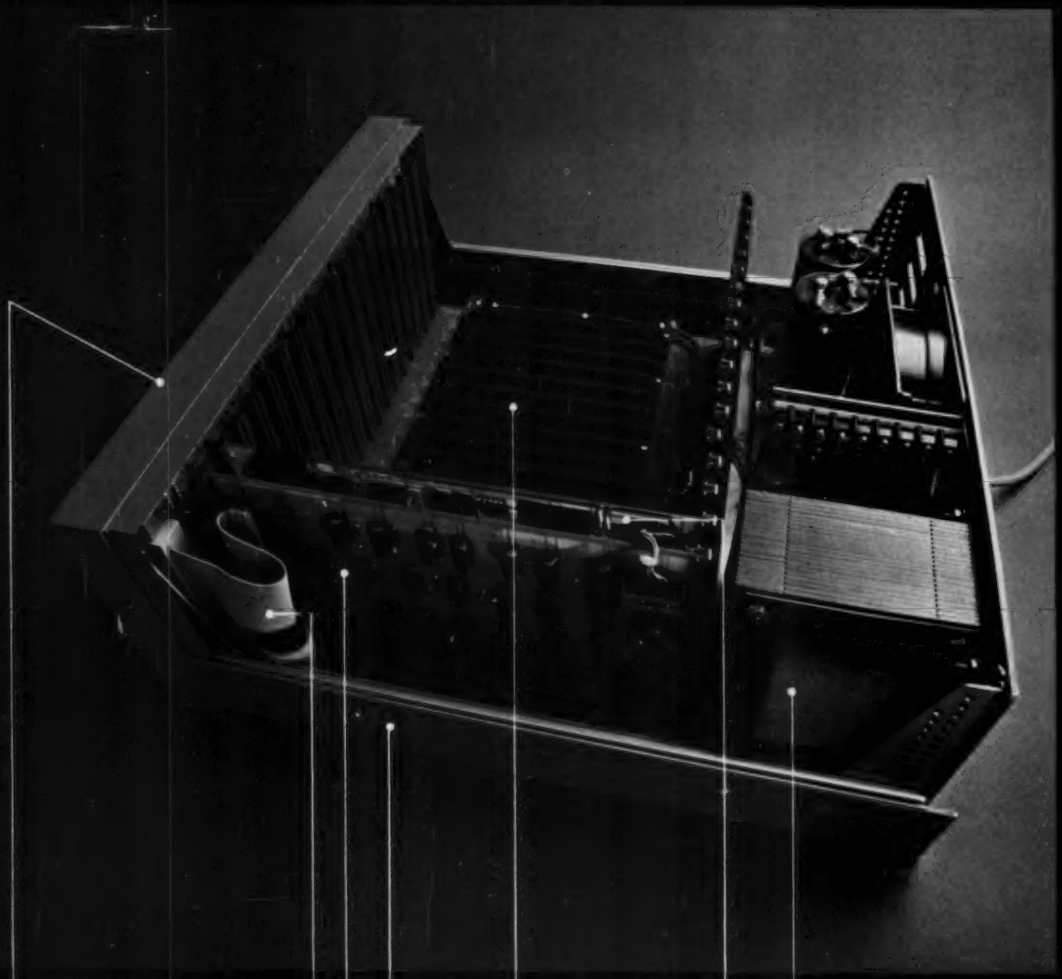
You are imagining the Altair™ 8800b. The Altair 8800b is here today, and it may very well be the mainframe of the 70's.

The Altair 8800b is a second generation design of the most popular microcomputer in the field, the Altair 8800. Built around the 8800A microprocessor, the Altair 8800b is an open ended machine that is compatible with all Altair 8800 hardware and software. It can be configured to match most any system need.

Introductory prices for the Altair 8800b are $840 for a kit with complete assembly instructions, and $1100 for an assembled unit. Complete documentation, membership into the Altair Users Club, subscription to "Computer Notes," access to the Altair Software Library, and a copy of Charles J. Sippl's Microcomputer Dictionary are included. BankAmericard or Master Charge accepted for mail order sales. Include $8 for postage and handling.

Shouldn't you know more about the Altair 8800b? Send for our free Altair Information Package or contact one of our many retail Altair Computer Centers.

MITS, Inc. 1976/2450 Alamo S.E. / Albuquerque, New Mexico 87106



Redesigned front panel. Totally synchronous logic design. Same switch and LED arrangement as original Altair 8800. New back-lit Duralith (laminated plastic and mylar, bonded to aluminum) dress panel with multi-color graphics. New longer, flat toggle switches. Five new functions stored on front panel PROM including: DISPLAY ACCUMULATOR (displays contents of accumulator), LOAD ACCUMULATOR (loads contents of the 8 data switches (A7-A0) into accumulator), OUTPUT ACCUMULATOR (Outputs contents of accumulator to I/O device addressed by the upper 8 address switches), INPUT ACCUMULATOR (inputs to the accumulator from the I/O device), and SLOW (causes program execution at a rate of about 5 cycles per second – for program debugging).

Full 18 slot motherboard.

Rugged, commercial grade Optima cabinet.

New front panel interface board buffers all lines to and from 8800b bus.

Two, 34 conductor ribbon cable assemblies. Connects front panel board to front panel interface board. Eliminates need for complicated front panel/bus wiring.

New, heavy duty power supply, +8 volts at 18 amps, +18 volts at 2 amps, 18 volts at 2 amps. 110 volt or 220 volt operation (50/60 Hz). Primary tapped for either high or low line operation.

New CPU board with 8080A microprocessor and Intel 8224 clock generator and 8216 bus drivers. Clock pulse widths and phasing as well as frequency are crystal controlled. Compatible with all current *Altair 8800 software and hardware.

altair 8800-b

Price, specifications subject to change. Please allow up to 60 days for delivery.

I/O REPORT

by John Craig

PERSONAL COMPUTING '76

We just returned from Atlantic City NJ after a tremendous weekend at one of the best conventions the hobby community has had yet. The convention was sponsored by the Southern Counties Amateur Radio Association of New Jersey, Inc. The whole thing was practically a three-man show, with the bulk of the work and coordination being done by John Dilks K2TQN Dave Jones WA2AML, and Jim Main WB2UON. With over 3,000 in attendance, you can bet these three gentlemen (and their associates) had their hands full!

About the only thing I found lacking were booths set up for individuals to display their systems. Since ham radio is one, if not *the*, area which has found some truly interesting applications for microprocessor systems, it would seem there could have been some fascinating exhibits set up by local hams. Needless to say, an adjustment to the $100 fee for a booth would be necessary before many folks would even consider bringing their systems to Atlantic City for just show.

KILOBYTE

Personal Computing '76 provided the "launching platform" for our new magazine, *Kilobyte*. (As you probably know, the publisher of *Kilobyte* is also the man who started *Byte* magazine . . . and it turns out he has a neat sense of humor when it comes to such things as magazine names!) The *Kilobyte* booth was one of the most popular at the convention and I'm not sure if it was because we had some of the most interesting merchandise on display or because we had some of the most interesting (and cute) young ladies behind the counter! Besides the *Kilobyte* subscriptions (which were being bought left and right), we had recent back issues of *73*, computer and ham books, code tapes, and much more. We also had a *Kilobyte* drawing for a Windjammer cruise for two through the Caribbean. Byron Young of Pasadena TX was the lucky winner of that little jaunt.

One of the questions we heard most concerning *Kilobyte* was, "What is it going to provide that the other magazines don't?" It's for sure we'd be spinning our wheels if we didn't have plans for *Kilobyte* to be unique and special. One of the things we will definitely be providing through the pages of *Kilobyte* will be articles dealing with both hardware and software for the beginner. Now, stop and think about that for a moment: There are hardware types *and* software types in this computer "business" and it's very seldom that a person is well-versed in both areas. If you're one of the hardware group who enjoys designing and building state of the art circuits, it's very likely you have a lot to learn about the programming end of things. And, if you're a top-notch programmer, you probably have a lot of questions about the hardware end. (Heck, you might even have those questions if you're a mediocre programmer!) Then, of course, there's the poor guy just getting started in this whole mess who doesn't have much to carry him through except determination and a keen desire to learn.

These articles are going to be just what you've been looking for. We're not going in for straight tutorial material . . . instead, you'll be reading articles which have good practical examples we can all relate to, and good, useful, practical applications.

Kilobyte will also be covering applications in both the home and small businesses (and you can be sure that a lot of these "hobby" efforts are going to be shifting over in the direction of developing small business systems). You can be just as sure of keeping up-to-date on developments in this area through *Kilobyte*.

We're looking for programs for the *Kilobyte Software Library*. This is going to be *the* place for getting applications programs, games, educational programs, diagnostics and other software for making your home system something more than just an ol' light blinker. It's going to be a fantastic deal for you, the programmer, because you will have a means of marketing your programs and being paid a royalty on each copy sold. (These programs are going to be distributed throughout the country at computer stores, as well as being advertised and sold through *73* and *Kilobyte*.) It's going to be great for *everyone* because we'll finally have somewhere to go for the software we've all been craving!

PETERBOROUGH, NEW HAMPSHIRE

After the Atlantic City convention, I drove up to New Hampshire with *73*'s computer engineer, Jim Muehlen. This was my first trip to the northeast and I'm still in a state of shock over the fact the toll road charges we paid during that trip were almost double the cost of the gasoline!

Looking at the brighter side of things . . . let me tell you about Peterborough! It's a truly beautiful and quaint little New England town with some of the friendliest people you'll find anywhere. And, if you're ever passing through around eatin' time, be sure and stop at the *Folkway Restaurant* for some fine dishes (and some unusual company . . . such as Carl Helmers, the editor of BYTE).

The group at *73* is a sight to behold, also. Some wonderful and dedicated people put together this magazine you all enjoy so much. The house in which all this takes place is a 200 year old mansion which has more rooms than any one man could count in a lifetime. It's a beautiful place with a lot of atmosphere, and if you ever read one of Wayne's "ads" for help up in Peterborough, *you could do worse than to answer it.*

STEVE CIARCIA'S VIDEO GAME ARTICLE

The October *73* had an article by Steve Ciarcia entitled, "Hey, Look What My Daddy Built!" It described the construction of a video game using the 8 game AY5-8500 chip manufactured by General Instruments. It seems there aren't too many places where one can get hold of this chip. He (Steve) has been deluged with requests on where to get it, and the phone at *73* hasn't stopped, either. We've been told that the chip is available for $39.95 from Advanced Micro-Computer Products, P.O. Box 17329, Irvine CA 92713. The latest Heathkit video game (released in October) uses the same chip and sells for $49.95.

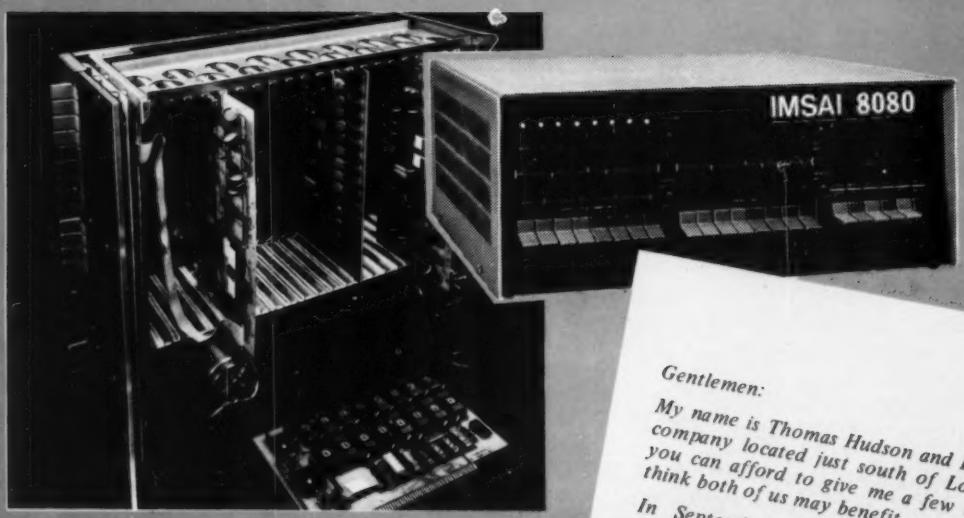
NEW PRODUCT REVIEW

Oliver OP-80A Tape Reader

The OP-80A "high speed" paper tape reader is probably one of the least expensive and easiest devices you're going to run across for getting programs into your computer. Unlike most other paper tape readers, you won't have to worry about mechanical repairs and alignments . . . since the movement of the tape is accomplished by pulling it through the reader. Then, on the other hand, you're not going to

Continued on page 121

OP—80A
I/O SOCKET
D0 1 BRN RED 16 D1
D2 2 ORG YEL 15 D3
D4 3 GRN BLU 14 D5
D6 4 VIO GRY 13 D7
ACK or ACK 5 WHT BLK 12 SPARE
RDA 6 BRN RED 11 S2
RDA 7 ORG YEL 10 S1
GROUND 8 GRN BLU 9 +5vdc
D0 thru D7 = DATA OUTPUT BYTE
S1 and S2 = STATUS LEDS
RDA = READER DATA AVAILABLE (⌐L)
RDA = READER DATA AVAILABLE (⌐⌐)
ACK or ACK = ACKNOWLEDGE (Resets RDA and RDA) (⌐L) or (⌐⌐)
POWER = +5vdc @ 175ma MAXIMUM



IMSAI 8080 Kit, $540.00
IMSAI 8080 Assembled, $829.00
IMSAI 4K Low Power Memory Board, $125.00

Gentlemen:

My name is Thomas Hudson and I am President of a small company located just south of Los Angeles, California. If you can afford to give me a few minutes of your time, I think both of us may benefit.

In September of 1975 I decided to attempt to sell microprocessor-based computing systems to the commercial market. I visited every microprocessor-based kit manufacturer in the United States, and questioned numerous people in the industry. For many reasons, all of which hold true today, I decided on the Intel 8080 family of microprocessors as the best hardware choice. In November of 1975 we decided on a product offered by a company in San Leandro, California, IMS ASSOCIATES INC. Before Christmas we had 3 IMSAI 8080 kits on the way, and they have operated flawlessly ever since we turned on the power. We still use these original kits as development tools and for some really neat games. The IMSAI 8080 microprocessor kit is of the highest quality available. Company management is excellent, the engineers are first-class, deliveries are almost on time (within days, not months), and the ability to run DEC derived BASIC and FOCAL is a powerful not to be overlooked advantage. Once over the usual arguments for and against various chips, assuming you decide (wisely) on the 8080, the obvious best choice is IMSAI. I feel from experience that you cannot buy a better microprocessor-based kit.

OTHER PRODUCTS OF EXCEPTIONAL MERIT

The I/O board and printer were developed for our in-house commercial products. They are extremely well-built, of high quality and are excellent for the discriminating hobbyist.

MMI Model I/O *PENER*

6 PORTS of parallel which can be any combination of in and out (software control)
5 PORTS in and 1 out, 2 in and 4 out,etc.
2 PORTS serial interface, or 20 mil current loop and one RS 232 or both PORTS either type.
Board select 110 to 9600 baud.
Kit price $219.95/each
DECWRITER LA 36 II 30 CPS printer brand new in box from factory, air shipped to your door $1776.00

MMI Model 40P

5 x 7 dot matrix impact type

40 column alphanumeric printer w/PS, case and interface to IMSAI/MITS
Double size print under software control – 1.25 lines per second.
Assembled price $599.00/each
Introductory price $519.00/each

TERMS: Cash, check, or money order. We cannot accept any charge cards; however your bank will advance you the cash – your payments are the same. Make out your check and mail to:

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Inquire as to quantity club discounts – IMSAI products only.

SWTPC 6800

- ★ COMPLETE WITH 2K OF MEMORY
- ★ SERIAL INTERFACE
- ★ STANDARD ROM MONITOR (Motorola MC 6830L7)
- ★ 4K AND 8K BASIC AVAILABLE

Always the best value in hardware and now an outstanding selection of software too. What more could you want in a computer system? For less than four hundred dollars you get everything you need—ready to connect to a terminal and go to work. No surprises no funny business, just good reliable hardware in a very practical system that may be expanded to meet almost any later need.

Memory and interfaces are not extra cost items in our system. A standard Motorola MIKBUG® ROM monitor makes the system completely compatible with Motorola software and eliminates any need for console switches and light. Data may be entered from the terminal in convenient hexidecimal form. The power supply is adequate to operate a fully expanded system with up to 24K of memory and up to eight (8) interfaces—simultaneously.

See the 6800 and our peripheral equipment at your nearest dealer, or write for a complete description.

MP-68 COMPUTER KIT—with serial interface, 2k of memory and ROM monitor **$395.00 ppd**

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See SWTPC computer equipment at your local dealer

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Dublin, Ca. 94566
(415) 828-7480

Computerware
830 First St.
Encinitas, Ca. 92024
(714) 436-3512

Cyberdux
Microcomputer Applications
1210 Santa Fe Dr.
Encinitas, Ca. 92024
(714) 279-4189

A-VID Electronics Co.
1655 East 28th St.
Long Beach, Ca. 90806
(213) 426-5526

The Byte Shop Computer Store # 1
1063 El Camino Real
Mountain View, Ca. 94040
(415) 969-5464

The Computer Center
8205 Ronson Rd.
San Diego, Ca. 92111
(714) 292-5302

Computer Store of San Francisco
1093 Mission St.
San Francisco, Ca. 94103
(415) 431-0640

The Byte Shop Computer Store # 2
3400 El Camino Real
Santa Clara, Ca. 95051
(408) 249-4221

The Computer Store
820 Broadway
Santa Monica, Ca. 90401
(213) 451-0713

FLORIDA

Electronics for Yachting, Inc.
2001 S.W. 20th St.
Ft. Lauderdale, Fl. 33315
(305) 525-3479

Computer Assoc., Inc.
6900 N. Kendall Dr., Suite A103
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A Ham's Computer

-- CW/RTTY the easy way

For several years I have experimented with, built, and operated different items of SSTV equipment. From that experience I tried my hand at building an all solid state RTTY TVT which was recently described in *73 Magazine*.[1] In monitoring ham RTTY transmissions on the West Coast, it was noted that the subject of microcomputers and their application to ham radio was being discussed in increasing frequency. My curiosity was aroused about this new development in ham radio.

I was fortunate in being able to visit Dr. Robert Suding WØLMD several times during business trips, and observed the development of the microcomputer that is now marketed by The Digital Group of Denver, Colorado.[2] For my "hands-on" experiments in microcomputers, I purchased their type 8080-4BD kit. I feel that I was probably like other hams and did not have the slightest notion of how this thing worked, but figured to just jump in and have a go at it. I must say it has been a very interesting project. I am slowly learning to live with the new system and to use it in some practical applications.

System Description

The 8080-4BD system as shown in the block diagram consists of several PC boards and the components that must be mounted on the boards. This includes the standard mother board, a CPU board with 2K of memory, an 8K memory board using 2102 ICs, a video display and cassette interface board, and a 4-port parallel I/O board.[3] The mother board will accommodate two more 8K memory boards and three more 4-port I/O boards. Low profile sockets are used for mounting all ICs. An unmounted surplus keyboard with ASCII encoded output was also purchased from The Digital Group.

A 12 inch transistorized black and white TV set was used for the video display. The display consists of 16 lines of 32 characters per line. For the cassette "Read" and "Write" modes, I use a Superscope Model C-104 as recommended in the technical literature that accompanies the kit. Power supplies in both kit and assembled form are available from The Digital Group, but I chose to build my own. The cabinet for the mother board, PC boards and power supply was salvaged from an old obsolete tube transmitter. I also fabricated a cabinet for the keyboard assembly. The TV set was modified to accept video input from the computer.

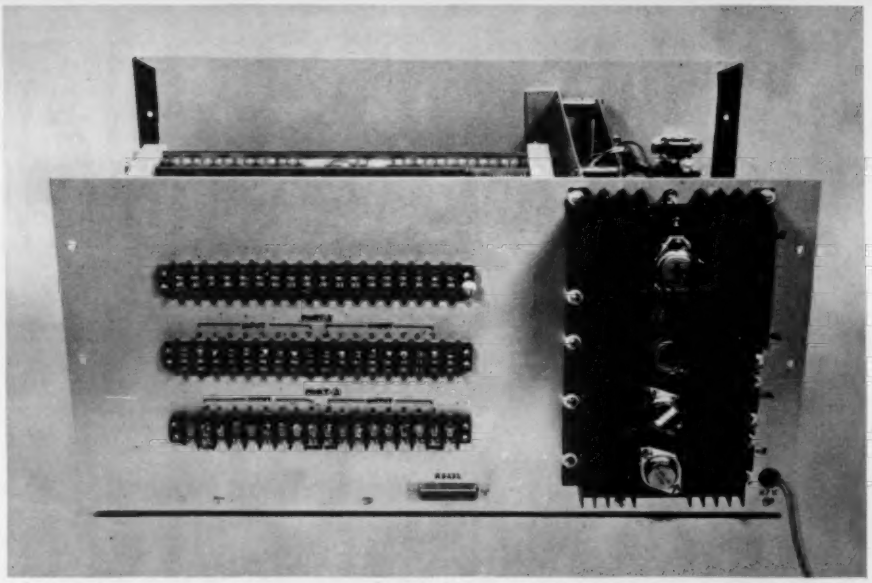
Included in the parts from The Digital Group is a prerecorded tape cassette that is used to initialize the system and to test out the memory card. It also has a game program, a program to make the unit act as a digital counter, a bicentennial demonstration program, and a ham CW and RTTY program. The bicentennial program on the tape prints an American flag on the TV screen to the accompaniment of *The Star-Spangled Banner*. As Dr.

Suding says, "So what else would you expect in 1976?"

Assembly of the System

It is stressed in the data furnished with the kit that the builder should have some experience in building electronic equipment other than assembling detailed kits from Benton Harbor. The data does not give that kind of step-by-step instructions. The quality of the PC boards is first class, with gold-plated connector contacts and double-sided boards with through-plated holes. General instructions on how to assemble each PC board are given, with a description of how the circuit works. A schematic diagram is furnished for each board, along with a general parts layout for that particular board. Testing and trouble-shooting information is also furnished in the data package.

In assembling my system, I discovered one board that was missing all the bypass capacitors. They were immediately replaced when The Digital Group was advised of the shortage. Another board had one low cost IC missing which I replaced from my junk box. Another board had one extra IC in the kit. After the unit was finally assembled and ready to test, I ran into several bugs. The characters on the video monitor were not complete, and it looked more like a foreign language than English. I found, after consultation with Dr. Suding, that I had a bit missing on the data lines going into the video board. This was determined to be caused by a lack of through-plating in one of the holes in the mother board. The next bug was that a portion of the dot structure was missing in the characters being displayed. This was found to be caused by a defective Motorola (MCM 6571L) character generator chip which was promptly replaced (once again) by The Digital Group. The last bug was that the encoder chip (TI TMS-5000) in the keyboard had to be replaced (as one row of keys was dead). With those bugs out of the way the system worked as designed.



The power supply shown in the diagram was home-made, and provides all the voltages required at the specified current loads. I had to salvage an old 6.3 volt 20 Amp transformer and rewind it with a new secondary for the high current 5 volt load. A second winding was also added for the +12 volt line. The crowbar circuit was added to protect all those expensive ICs on the memory and CPU card. Discussions with Dr. Suding indicated that anything less than 50,000 uF in the 5 volt power supply filter might lead to unwanted noise problems. I located just what was needed in a local surplus store and ended up with a 55,000 uF unit.

The cabinet for the computer is 18½ inches wide by 9 inches high by 12 inches deep. I cut two large square holes in the top and riveted in a perforated grille for better circulation of cooling air. A 4 inch fan is mounted on the compartment divider bulkhead between the power supply compartment and the PC board compartment. The air is directed over those warm memory chips. I have had no problems with overheated ICs. The MPC-1000 5 volt 10 Amp regulator is mounted on a very large heat sink on the back bulkhead, out in the open air. This way it does not dump its heat into the unit.

The 12 inch TV set was modified as per a TV typewriter article in *BYTE Magazine*.[4] The level of the video signal from the computer was more than the TV set could handle, and required additional line loading before the set began to display the signal on the screen at an acceptable brightness and contrast level. The builder should *not* use a TV set that does not have a power transformer providing power line isolation. Be sure that the set does not have a "hot" chassis with series string heater tubes. That type will really fry the ICs in a computer.

I found that when playing the cassette into the computer I could not monitor the audio signal, so I modified the recorder by adding a 100 Ohm resistor across the output jack switch contacts so that the speaker was in the circuit even when an audio line plug was connected to the recorder output. It is convenient to monitor the mark frequency tone as the program playback begins and ends.

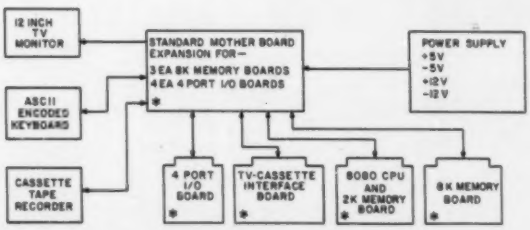


*Fig. 1. Block diagram of microcomputer system at K7YZZ. *Items basic to the 8080-4BD kit.*

Initial Test

When power is applied to the system there should appear on the top of the TV screen "Read 8080 INITIALIZE Cassette." If this message appears, all is well. The first program on the audio cassette furnished with the kit is loaded in the recorder. At the start of the mark frequency tone the "Reset" button on the com-

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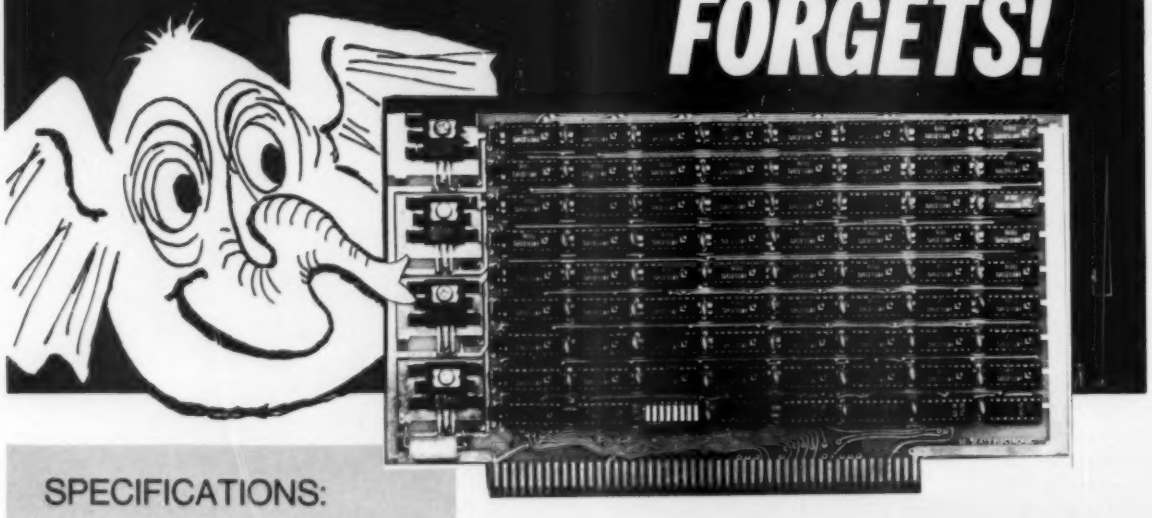

SPECIFICATIONS:

8K SC-8 Specifications:

Access Time:	500 ns Max. (225 max on request)
Current Req:	Less than 200 ma per 1024 words maximum
Memory Chip:	AMD 91L02 APC (low power 1K x 1)
Voltage Supply:	+5 to +10 volts
Battery Standby:	1.5 to 2 Volt, Automatic power loss sensing circuit. Eliminates need for switches.
Address Select:	8 ea. Spst. switches in a Dip IC package. (No longer any need for a soldering iron to change address.)
+5 Volt regulated:	4 ea. 7805 regulators with individual heat sinks to run cooler.
Wait States:	NONE! Your wait light will not burn because of a memory wait state.

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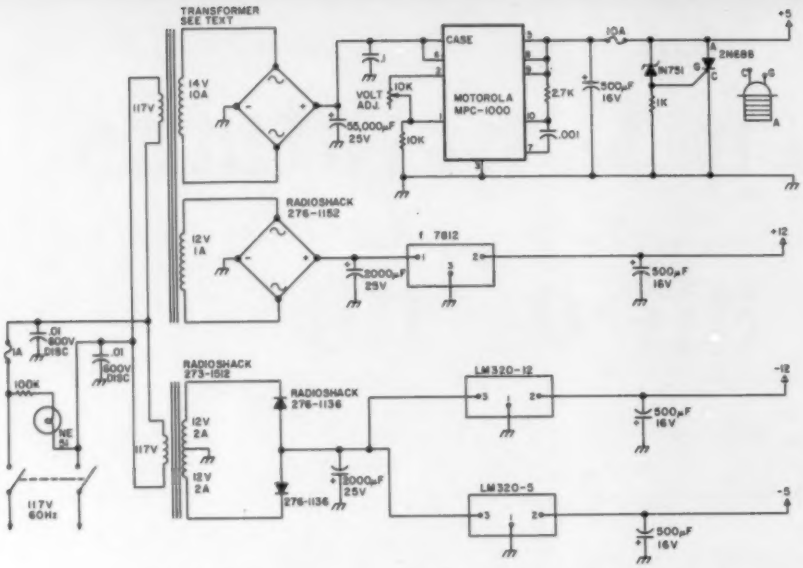


Fig. 2. Power supply for The Digital Group 8080-4BD.

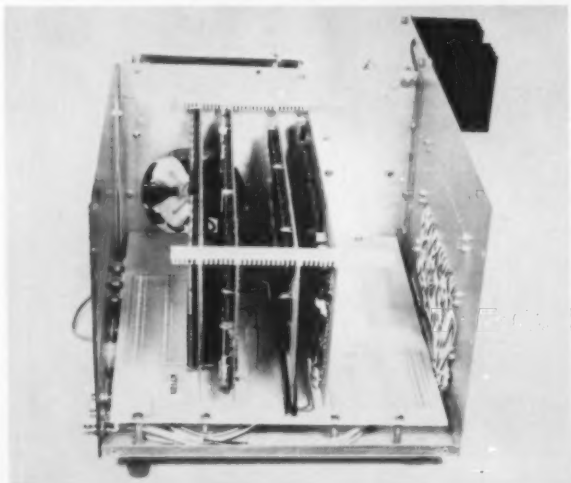
puter is depressed for a moment. The computer then begins to accept the digital data recorded on the tape. As the data is loaded into the computer, the TV screen will display lines of a running series of numbers beginning with 1 through 7, and back to 0 through 7, until the program is loaded. This represents each page of program data being loaded into memory. At the end of the program tape, the mark tone will return and the screen will display "8080 OP SYSTEM" and the options. Selecting item 4 of this listing (hit key 4) will permit the operator to begin generating a program from the keyboard beginning at page 6. Program development using this tape will be in the octal code format. Other prerecorded programs on the tape, such as the "Memory Check," are used to determine if all of the memory ICs are OK. The tape for that program is loaded and key 6 is depressed. The TV screen goes blank until all the memory chips are tested. Then, if all is OK, an alpha sign appears in the upper left hand corner of the screen and another run is automatically begun. Each successful test provides another alpha figure on the screen. For the 2K memory the check time is just a few seconds; for the 10K memory it takes about a minute to run the test. If a defective memory IC is located, it will stop the test and print on the TV screen which IC is defective and on which circuit board the IC is located. This really works, as I tried some known bum chips and it located them very promptly.

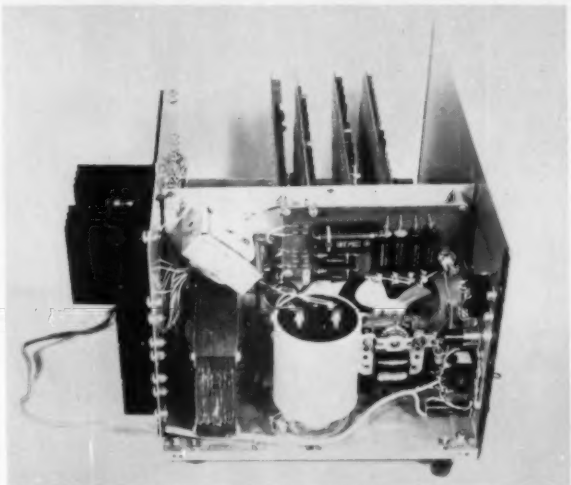
At first I was very apprehensive about pushing that "RESET" button, or switching off the power to clear the memory for a new program entry, but after a while I found that it did not damage the machine. I became more confident of the machine and its operation.

Operation

The Digital Group has established a branch called The Digital Group Software Systems, which supplies cassettes of games and other items, such as a Tiny BASIC Extended.[5] I obtained all the games (that are available to date), including the Tiny BASIC Extended. Most of the games are written in Tiny BASIC and must have the Tiny BASIC program loaded in the computer before they can be played. The machine is turned on, and when the initialization statement appears on the TV screen the Tiny BASIC tape is loaded. Then the selected game tape is loaded by keying 1 on the keyboard when the mark tone appears at the beginning of the tape.

The blackjack game is fun to play, and some of the locally trained (Las Vegas) experts tell me it is a very well written program. It has all of the game's rules well executed. I condensed all of my games onto two tapes. I recorded the Tiny BASIC program at the beginning of each tape and then recorded around 10 to 12 games on each tape. There is still plenty of tape left for additional games. The magnetic tape cassettes are of the 30 to 46





minute type. Longer tapes are too thin to make good recordings of digital data.

A new ham cassette is in the works at The Digital Group Software Systems[6] and will have expanded capability for both sending and receiving CW and RTTY (with up to 8 storage slots of 100 characters each).

I have had some success at trying to program some games using the Tiny BASIC Extended. (Incidentally, the Tiny BASIC Extended does not have floating decimal or square root math capability.) I feel that these programming efforts have been the most informative and effective way to learn just what you can and cannot do with the machine. Also, you can be sure that it will tell the operator when he has goofed, in no uncertain terms.

Conclusions

The construction of the microcomputer turned out to be no more difficult than most SSTV construction projects. The biggest problem is acquiring an understanding of the machine and learning the Tiny BASIC Extended language. Computer terminology is almost like listening to a foreign language. I can assure the reader that after continued exposure to this new technology the terms and functions will begin to make sense. I should also like to warn the reader that this machine is addictive. You will find yourself sitting in front of that keyboard for hours trying out first one thing, then another. It is absolutely fascinating. Try it, and see for yourself. ■

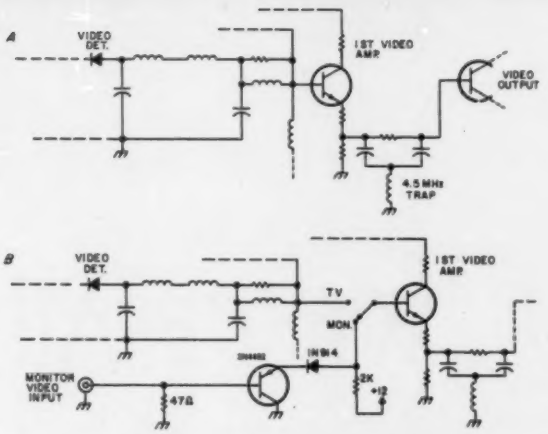


Fig. 3. (a) TV circuit before modification. (b) TV circuit after modification.

References

[1] "Build This Exciting New TVT," Louis Hutton, *73 Magazine*, March, 1976.

[2] The Digital Group, PO Box 6528, Denver CO 80206.

[3] The cost breakdown for the system's major components is as follows: 8080-4BD four board system with 10K RAM – $625; TV set (new K-Mart unit, 12 inch solid state) – $69; surplus keyboard with ASCII output, less cabinet – $49 (plus chip, $10); tape recorder, Panasonic SUPERSCOPE, model C-104 – $119; power supply, cabinet, fan – junk box surplus.

[4] "Television Interface," Don Lancaster, *BYTE Magazine*, October, 1975.

[5] The prerecorded cassette programs and games are sold by The Digital Group Software Systems, Inc. The game cassettes with software are $5 each. The Tiny BASIC Extended program with software instructions is $5. The Educator tape for the 8080 system with software instructions is $10. There is a Ham cassette with software instructions for $5. It provides Baudot RTTY send and receive, and also CW send and receive.

[6] Digital Group Software Systems Inc., PO Box 1086, Arvada CO 80001.

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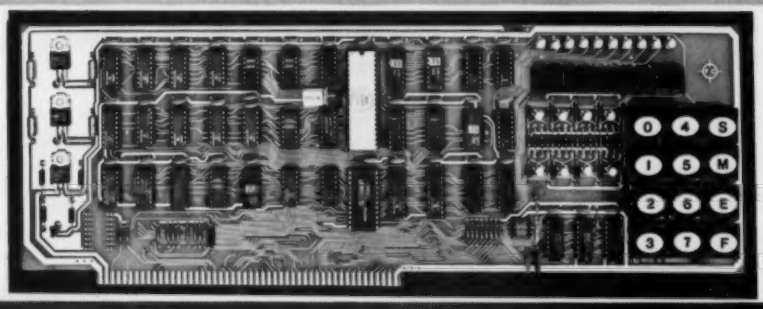

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What's All This LSI Bunk?

-- an ostrich's eye view of the microprocessor

Last year a small company called MITS introduced a new product that may eventually be as exciting as the first crystal radio, first FM receiver, or the first television set. The product was a computer in kit form that cost less than $500. Fig. 1 shows the completed version of the MITS Altair 8800. In this article we will explore how such inexpensive computers became possible and how we can use these new devices. The science fiction dream of a home computer has become real; already hobbyist clubs and stores that specialize in home computers have sprung up across the country. The world of computers, which was formerly only open to large institutions and specially trained experts, has suddenly become open to anyone with some time and some space in a house or garage.

Let's start at the beginning (last year!). How, in these days of 75¢ loaves of bread and $3500 Volkswagens, can a computer cost less than $500? In fact, prices for computers and such items as printers, television displays, and extra memory continue to go down. We can now buy computers and the devices that go along with them from many sources for prices that seem incredible.

The main reason for these developments is the emergence of large-scale integration (LSI) in semiconductor technology. Fig. 2 shows some of the developments in large-scale integration in the last ten years. Manufacturers can now place the equivalent of 10,000 transistors on a

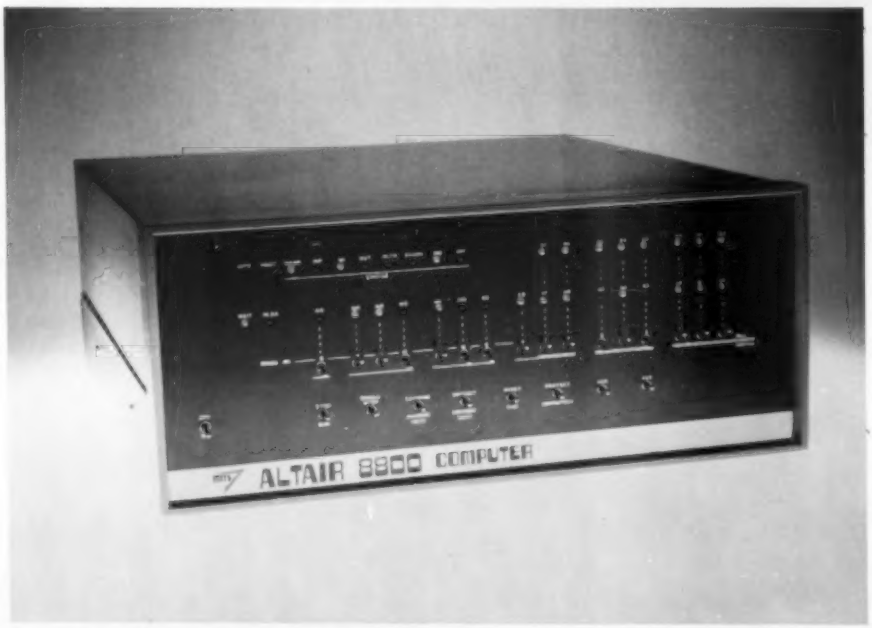

Fig. 1. The MITS Altair 8800, the first home computer (courtesy of MITS, Inc.).

piece of silicon less than a quarter of an inch square; this number has doubled each year for the last ten years and is likely to continue doing so for the next ten years. LSI has already led to the electronic calculator and the electronic watch. In the early 1970's, semiconductor manufacturers found it possible to place circuitry that would perform all the functions of the central processing unit (CPU) of a computer on one or a few chips. We call such computers on a chip *microprocessors*. Fig. 3 is a photomicrograph of the Motorola 6800, one of the most popular microprocessors; note the tremendous amount of detail present in a device with an area of less than one twenty-fifth of a square inch. Almost two years of work goes into the design and testing of such a device; however, once designed, the chips can be produced at the rate of thousands per hour for a manufacturing cost of a few cents apiece.

A Brief Historical Perspective

The main reason for the low price of hobby computers is the use of microprocessors. A microprocessor will fetch instructions from memory and decode them, accept data from memory or outside sources, perform arithmetic or logical operations and save the results in memory or send them to external displays or other devices. A microprocessor will thus do everything that a large central processor will do, even those which are the heart of enormous computers like the IBM 370, Burroughs 6700, or Control Data 7600. Yet the microprocessor is built on one or a few chips of silicon and costs only $10 to $100.

The microprocessor is an outgrowth of MOS LSI technology. MOS, metal oxide semiconductor, is the name for a device fabrication process which allows very complex devices to be placed on a single chip. The MOS LSI technology uses masking processes which we can compare to those used in photography. The manufacturing cost of MOS LSI devices, like the developing costs of photographs, is relatively independent of the amount of detail involved. The cost of developing a picture with a million precise details is the same, in terms of paper and chemicals, as the cost of developing a picture taken without removing the lens cap. Of course, the more detailed photograph requires a better camera, more attention to layout, and greater photographic skill; it is also less likely to turn out correctly. The production of complex MOS LSI chips is similar to the development of detailed photographs. Since the production cost of a complex chip is not markedly different from that of a simple chip, the more that can be placed on a single chip, the cheaper the overall system will be. Such a single-chip system will require fewer packages and connectors, less power, less labor, and a smaller amount of other supporting circuitry and equipment. LSI thus results in lower total cost if we can use the same LSI devices over and over again. LSI-based systems will also be smaller, cheaper to run, and more reliable.

MOS LSI techniques were first used to create compact, low power memories. In the late 1960's, these techniques were used to create electronic calculators; the first such devices were multi-chip systems which retailed for several hundred dollars but could do little more than today's $10.00 or $15.00 devices. Remember that just ten years ago the large mechanical calculator and the slide rule were the state of the art. In the early 1970's, the quickly changing calculator market made semiconductor manufacturers look for new ways to produce more general and more flexible devices which could be produced in large volumes and yet could be modified by the calculator manufacturers to meet new or custom requirements.

Manufacturer	Microprocessor Used
The Digital Group Denver, Colo.	Intel 8080, Zilog Z80, Motorola 6800, & MOS Tech 6502
E and L Instruments Derby, Conn.	Intel 8080
EBKA Industries Inc. Oklahoma City, Okla.	MOS Technology 6502
Electronics Product Associates, Inc. San Diego, Calif.	Motorola 6800
Gnat Computers San Diego, Calif.	Intel 8080
IMS Associates San Leandro, Calif.	Intel 8080
Infinite Inc. Cape Canaveral, Fla.	RCA COSMAC
Martin Research Northbrook, Ill.	Intel 8080
MITS Albuquerque, New Mex.	Intel 8080 Motorola 6800
MOS Technology Norristown, Pa.	MOS Technology 6502
Mycro-Tek Wichita, Kan.	Intel 8080
Ohio Scientific Instruments Hiram, Ohio	MOS Technology 6502 Motorola 6800
Pehaco Corp. Los Altos, Calif.	MOS Technology 6502
PCM Corp. San Ramon, Calif.	Intersil 6100
Polymorphic Systems Goleta, Calif.	Intel 8080
RCA Somerville, N.J.	RCA COSMAC
Southwest Technical Products San Antonio, Texas	Motorola 6800
Sphere Corp. Bountiful, Utah	Motorola 6800
Wave Mate Gardena, Calif.	Motorola 6800

Table 1. Manufacturers of educational and hobby microcomputers. Note: Many of the largest manufacturers of microprocessors and microcomputers are not included in this list because their products are intended for industrial applications.

The first microprocessor, the Intel 4004, was developed for a calculator manufacturer. Although it was designed primarily for the calculator market, it was programmable; its actual functions could be changed by the calculator manufacturer rather than being fixed by the semiconductor manufacturer. The power of the microprocessor and its advantages over hard-wired design soon became evident to other industries. The first 8 bit microprocessor (the Intel 8008), directed largely toward manufacturers of computer terminals, was introduced in 1971.

The complete history of the microprocessor is thus only five years long. Already, though, processors are in common use which are a hundred times as powerful as the early 4004 and 8008; such processors can do more than could large computers of 15 years ago which cost (in uninflated money) over $100,000.00. Nor have we yet come close to reaching the limits of microprocessor performance; many of today's limitations will disappear as manufacturers continue to produce more complex LSI chips.

A Microprocessor Survey

Let's take a look at some of the existing microprocessors from the hobbyist's point of view. We will pay particular attention to those microprocessors which are widely used as central processing units in hobby computers.

Current microprocessors can be divided into three

Fig. 2. LSI developments from 1966 to the present.

basic categories:

(1) Calculator-like processors

(2) Standard, self-contained processors with a fixed instruction set

(3) Bit-sliced processors and others with a user-defined instruction set

The three categories include a wide range of computing power, speed, price, and application areas. Category 2 contains all of the microprocessors used in hobby computers. Therefore, we will briefly describe categories 1 and 3 and focus our attention on category 2.

Category 1, the calculator-like processors, contains the simplest and cheapest devices. Typical processors in this category are the Intel 4004 and 4040, Rockwell PPS-4, Texas Instruments TMS-1000, American Micro-Systems 9209, and National SC/MP. Many of these devices are much like calculators; they are often specially designed or have special instructions to handle keyboards and lighted displays and to perform simple decimal arithmetic. However, these microprocessors are user-programmable (unlike calculator chips) and can be used in a wide variety of applications. Besides advanced calculators, such devices have been used in character printers, games, household appliances, paper tape readers, test sets, function generators, counters, microfilm readers, telephones, tuners, valves, scales, cash registers, and time and attendance terminals. We may have hundreds of these devices in a single store, factory, or laboratory.

The devices of category 1 represent the smallest amount of computing power that can be purchased as a single unit. Complete systems based on these devices cost only $5 to $30 in large quantities. They are used mainly in applications requiring low cost, low speed, and relatively limited processing power. Such microprocessors are most often found in large volume applications as simple controllers for systems whose speed is limited by human interaction or slow mechanical devices. These processors generally have very short word lengths (most can only handle 4 bits at a time) and are thus unsuited to systems requiring complex calculations, high data rates, or great accuracy. Although these simple processors do not attract much attention from writers or researchers, they are still probably the most widely used in terms of volume because of their low cost.

We should note that computer speed is relative. We often call a computer slow if it can only execute 100,000 instructions a second! A large computer may be able to execute 10,000,000 instructions in that same time but the "slow" computer still seems to work at lightning speed to the average observer.

Category 3, the bit-sliced processors, are largely intended as building blocks for special-purpose computing elements. Typical microprocessors in this category are the National IMP, Intel 3000, Advanced Micro Devices 2900, Monolithic Memories 6701, Texas Instruments SBP0400, and Fairchild Macrologic. Unlike the devices in categories 1 and 2, the bit-sliced processors are not self-contained CPUs. Rather, they involve a whole family of elements including a 2 or 4-bit processor slice which the user must combine to form a CPU. Such a CPU will generally involve 30 to 50 discrete packages. These microprocessors are thus intermediate between the self-contained CPUs and the discrete circuitry that is currently used to make large computers.

Most of the bit-sliced processors are much faster than standard microprocessors, but significantly more expensive and harder to use. CPUs based on these processors typically cost $500 to $1500. Typical applications include disk controllers, minicomputer CPUs, test equipment, intelligent terminals, and signal processing equipment. In the near future, the bit-sliced processors may become the basis for most minicomputers. However, the cost and the number of elements required for a CPU will have to be significantly reduced before such devices can be used in hobby computers.

The main category of microprocessors with which hobbyists are presently concerned is category 2, the standard, self-contained processors with a fixed instruction set. These processors are intermediate in performance between calculators and minicomputers (i.e., between categories 1 and 3). They are complete CPUs on one or a few chips and require only a small amount of supporting circuitry. Prices range from $20 to $200 in single quantities (not including memory, I/O, or other system requirements). Most of these devices will handle 8 bits of information at a time, although a few can handle 16 bits at once. The most widely used microprocessors among hobbyists are:

Intel 8080 (the Intel 8008 is an older, less powerful version)

The Intel 8080 was the first device in this category to be introduced (in 1973) and is the most widely used CPU in hobby computers. It is used in the MITS Altair 8800, IMSAI 8080, and in similar sets from Martin Research and other sources. The Zilog Z-80 is an extended version of the Intel 8080 with a larger, more powerful instruction set and other extra features.

Motorola 6800

The Motorola 6800 is comparable to the Intel 8080 in performance (it was first introduced in 1974). It is used in the MITS Altair 680 and other hobby sets from Southwest Technical Products, Sphere, Wave Mate, and Ohio Scientific Instruments.

MOS Technology 6502

The MOS Technology 6502 is also comparable to the Intel 8080 and Motorola 6800 in terms of performance. It was first introduced in 1975 and is used in the JOLT hobby computer and others. The MOS Technology 6502 is somewhat cheaper than either the Intel 8080 or Motorola 6800, but not as widely used.

National PACE

The National PACE is slower than any of the previously mentioned processors and somewhat more expensive. It will, however, handle 16 bits of information at a time (the others handle 8) and has a more powerful instruction set. Systems based on this processor are available from Godbout Electronics and from Hamilton-Avnet (the Pacer).

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The Intersil 6100 is a new device which executes all the instructions of the world's most popular minicomputer, Digital Equipment Corporation's PDP-8. The advantage of the Intersil processor is that a tremendous number of programs are already available for the PDP-8. Systems based on this processor can be obtained from PCM Corp. or Ohio Scientific Instruments.

Other processors in category 2 which may eventually be used in hobby computers include the Rockwell PPS-8, Signetics 2650, RCA CDP 1802 (COSMAC), Fairchild F-8, and General Instrument CP-1600. Table 1 contains a list of some manufacturers of hobby computers and the processors they use. A new entry in this category is the Texas Instruments TMS9900 which handles 16 bits at a time like the National PACE but is just as fast as the Intel 8080 or Motorola 6800. The TMS9900 is presently more expensive (about $200 in single quantities) than the other microprocessors mentioned above, but offers much more processing power.

Of course, the devices in category 2 have found many applications besides hobby computers. Among the more common are monitoring systems, line printers, navigation systems, business machines, test equipment, security systems, programmable terminals, plotters, oscilloscopes, machine tools, industrial-control systems, message switching units, graphics terminals, and medical instruments. These processors will probably continue to have the widest variety of applications in the near future.

Semiconductor Technologies

Now let's examine the characteristics of the semiconductor technologies from which microprocessors are produced. The importance of particular features will be described as well as technological trends that may be of significance to hobbyists.

The first question that must be answered is, "What characteristics are desirable in a semiconductor technology?" Some desirable characteristics are fairly obvious:

Low cost: If devices from a particular technology can be produced cheaply, the ultimate cost will be lower. Cost depends on the complexity of the semiconductor processes and on the amount of experience that has been acquired with a particular process. We should note that semiconductor prices vary widely and manufacturers' list prices often don't closely follow the actual prices charged by distributors or supply houses.

High Density: If more complex circuits can be placed on a single chip, fewer devices will be needed to perform useful functions. More complex chips are not usually much more expensive to manufacture, but require fewer packages, fewer connections, less board space, and less power than a larger number of simple chips.

Low power consumption: If the circuits produced from a particular technology require less power, they will need smaller power supplies, use less energy, and produce less heat. Devices that use large amounts of power will need expensive power supplies and special cooling mechanisms such as fans or air conditioning.

High speed: If the devices run faster, they can simply perform more work in a given amount of time.

Even these simple characteristics can't be easily combined – devices that run at high speeds usually dissipate a lot of power, for instance. Technologies that result in high speed also typically result in low density and relatively high cost. Tradeoffs will have to be made.

Other useful features in a technology that may not be quite so obvious include:

Compatibility with standard TTL circuitry: If devices made from a particular technology can be readily used with the standard 7400 series TTL integrated circuits, they can then be easily and cheaply interfaced to peripherals and other circuitry.

Ruggedness: If devices made from a particular technology are more rugged, they will be able to withstand temperature variations, moisture, power surges, noise, and shock. Devices that are vulnerable to various conditions will have to be protected by means of special circuitry or packaging.

Wide availability and support: Technologies that are produced by many suppliers and heavily supported will have more parts available, more compatible devices, and lower prices. Such a technology is likely to continue in use for many years.

Standard parts and large memories in the same or compatible technologies: Technologies that have such devices will be relatively easy to use in complete computer

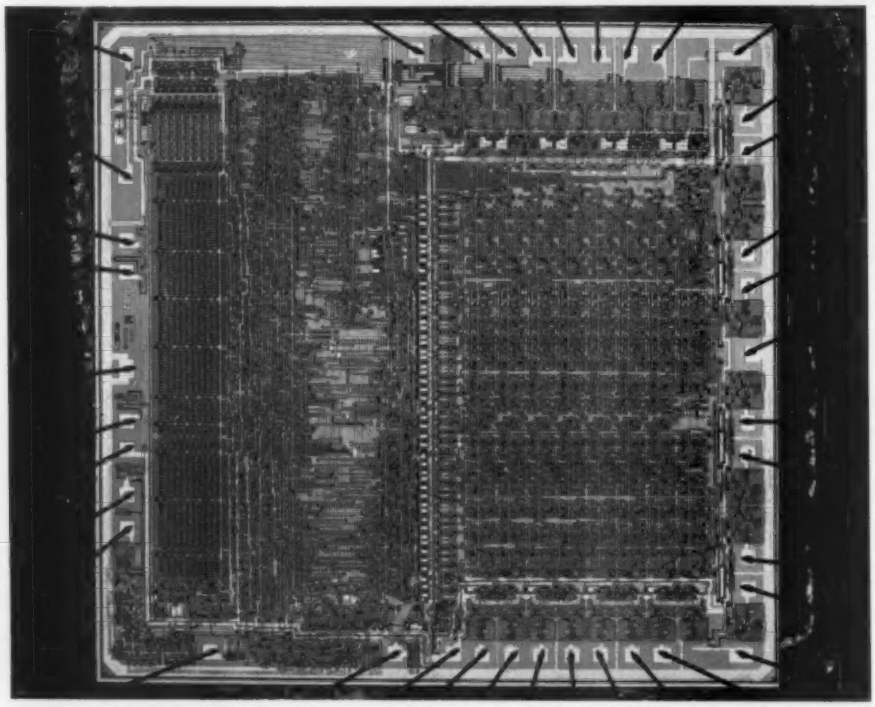

Fig. 3. A Photomicrograph of the Motorola 6800 microprocessor (courtesy of Motorola 6800 Semiconductor Products, Inc.).

systems.

Microprocessors are currently available in six different technologies:

PMOS (P-Channel Metal Oxide Semiconductor): the oldest MOS technology; high density and low cost but relatively low speed; not TTL compatible.

NMOS (N-Channel Metal Oxide Semiconductor): the present state of the art MOS technology; high density and moderate cost and speed; can be made TTL compatible.

CMOS (Complementary Metal Oxide Semiconductor): a technology widely used when low power consumption and high noise immunity are needed; medium in density, cost, and speed; can be made TTL compatible.

Schottky TTL (Schottky Transistor-Transistor Logic): a variation of standard TTL that offers high speed, but high power consumption and cost and low density; fully compatible with standard TTL.

ECL (Emitter-Coupled Logic): A very fast technology that is very expensive and consumes a large amount of power; not compatible with TTL.

I^2L (Integrated-Injection Logic): a new technology that may ultimately combine the speed of TTL with the density of MOS.

A comparison of these technologies is shown in Table 2. Clearly, PMOS and NMOS rank highest in the important categories of cost and density, CMOS ranks highest in ruggedness and lowest in power consumption, ECL is the fastest, while Schottky TTL is the easiest to interface.

	PMOS	NMOS	CMOS	Schottky TTL	I^2L	ECL
Cost (1 = Lowest)	1	2	4	3	5	6
Density (1 = Most Dense)	2	1	3	4	4	6
Power Consumption (1 = Least)	3	4	1	5	2	6
Speed (1 = Fastest)	6	5	3	2	3	1
TTL Compatibility	No	Sometimes	Sometimes	Yes	?	No
Ruggedness (1 = Most Rugged)	5	4	1	3	2	6
Availability and Support (1 = Most)	4	3	2	1	6	5
Standard Parts and Memories (1 = Most)	4	3	2	1	6	5

Table 2 Comparison of semiconductor technologies.

At the present time, NMOS seems to have the most desirable combination of characteristics. It is relatively cheap, very dense, consumes little power, can be made compatible with standard TTL circuitry, and has a family of large compatible memories. NMOS can be used to make single-chip microprocessors which run at reasonable speeds. Such commonly used microprocessors as the Intel 8080, Motorola 6800, MOS Technology 6502, and Fairchild F-8 are made from the NMOS process.

Furthermore, new developments in the NMOS technology should lead to considerable improvements. NMOS memories (like the Intel 2115) are now available that are as fast as memories made from Schottky TTL. The maximum size of the chips that can be produced from NMOS has also been increased. New NMOS processes have been introduced that can be easily interfaced with standard TTL circuitry and can use standard TTL power supplies. Significantly increased performance can be expected in the next few years from NMOS microprocessors.

As for the other technologies, the ones that will probably be the most interesting to hobbyists are CMOS and I^2L. Only a few processors (most notably the RCA COSMAC and Intersil 6100) are presently available in these technologies, but none has been widely used in hobby computers. However, single-chip microprocessors would appear to be possible in both technologies at relatively low prices. Such processors would not only be faster than NMOS processors, but would also use substantially less power and would be much more rugged. Microprocessors and large memories in these technologies may become available to hobbyists in the next few years. ■

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BE MY GUEST

visiting views from around the globe

from page 9

Wednesday and said he was told at the hospital that it did not have the proper equipment to treat Carden.

By that time, Smith and other hams had managed to get Carden's bail reduced from $9,000 to $2,700. But after appeals on the air only $1,700 had been pledged.

When Johnston learned that the courts in Mexicali were to close yesterday for a 30-day recess, he decided to go there and plead with Judge Rafael Moreno Henriquez, chief justice of the Superior Tribunal.

"Why should this boy lie there and pay with his life for a minor crime?" Johnston said he asked the judge.

Reduce the bail to an amount the hams could pay, Johnston pleaded. The judge agreed to do so. "He was a fine gentleman," Johnston said. He added that all government officials in Mexicali cooperated to the fullest to free Carden.

Johnston, who is coordinating the fund-raising effort, said that he had only $22 in hand from pledges made to him over the radio.

The 17 $100 bills used to free Carden yesterday were supplied by one ham who asked to remain anonymous. He is confident that the pledges will be made good.

Another ham told Hower he would make good any shortfall between the pledges and the bail.

Hower said the hams are not judging whether Carden is guilty. "If you find a man bleeding in the middle of the road, you help him," he said.

As word of the mission of mercy spread, Johnston got a call from a man in Oregon yesterday.

"He asked me if the company that rescued Robert could also save a man in Acapulco," Johnston said. "I told him that we are not a company, but a fraternal order just trying to be of service."

The hospital was to check today to see if Carden is a former serviceman entitled to VA treatment.

If he is, about the only reason he could be turned out of the hospital and refused treatment would be if he had been dishonorably discharged, a hospital spokesman said.

Martin Gerchen

Reprinted from the Evening Tribune *(San Diego), July 16, 1976.*

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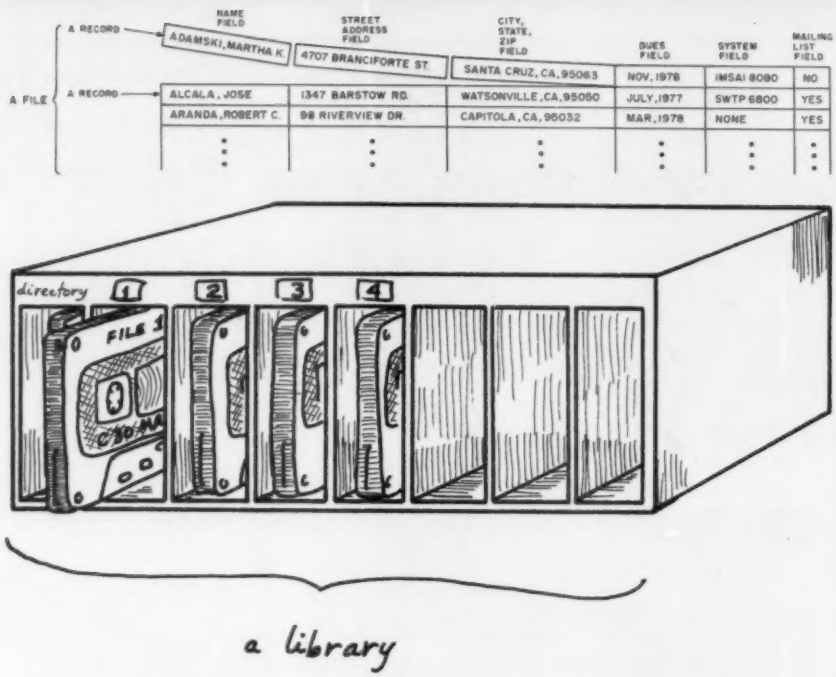

Fig. 1. Organization of the "data bank." Each file is stored on an individual cassette.

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The Soft Art of Programming

-- part III

(Here's the final installment of Rich Didday's series on BASIC programming. The article is written around a record-keeping program for computer club members . . . but the concepts presented will be applicable in many other areas as well. For the beginner, a lot can be learned from reading and analyzing the program — which holds true for experienced programmers, too. I'd like to invite you readers who sit down and develop the machine language routines for cassette read and write to submit them for publication. OK? — Ed.)

What we've been doing: In Part I we went over ways of learning the individual elements of the programming language BASIC, emphasizing that good programming involves planning things out long before you ever write any statements in BASIC (programming is a lot more than just coding). We played around. We had fun.

In Part II we began to put together sequences of computer instructions (BASIC statements) in order to carry out a substantial, useful task — namely, the record-keeping requirements of our computer club. We saw ways of using arrays, ways of estimating how much memory our program would need for data storage, ways of cutting down on memory usage. We got frustrated.

In this, the concluding part, we'll finish the record-keeping program by pulling together the ideas we laid out last time, with some major improvements. We'll emphasize the notion of

developing our program part by part, keeping the user's convenience and our overall objectives clearly in mind. We'll be satisfied, ready to go onward and upward.

At last! We're finally ready to finish our record-keeping program. Before plunging into the details of the finished program, let's be sure we have the big picture firmly in mind.

Fig. 1 shows the organization of our "data bank." There is a *record* for each member. Each record consists of six *fields* which store specific information about that member. A *file* consists of some number of records, the only restriction being that the number of records on a given file can be no more than will fit in memory at once. We'll store each file on a separate cassette tape, so we'll use the terms *file, tape,* and *tape file* pretty much interchangeably. In addition to the tapes storing membership records, there is one more which stores a *directory* which we'll use to enable our program to decide which tape file it needs to find a specific member's record. The directory tape together with the membership record tape files make up the *library.*

Our program must initialize and maintain the library, calling for and rewriting tape files as the need arises (based on the commands the user gives at the terminal). The four commands ADD, DELETE, LIST, and END seem sufficient for our needs. Fig. 2 describes each command and shows the basic structure of the program.

So far, the only difference from last month's plan is the inclusion of a directory. It is a big difference, though, because the directory, coupled with a more reasonable way of organizing the records (namely, keeping them in alphabetical order instead of in no order like last time), will make the system much more convenient to use. For now, let's follow through in a "top-down" way and code the main structure of the program, the part shown in the flow chart in Fig. 2. We'll leave the details for subroutines which we'll work out one by one. This general strategy is sometimes called "top-down programming" and sometimes "modular programming." The idea is that by breaking the problem down into manageable chunks, you're less likely to get confused, and more likely to keep all your objectives in mind as you go.

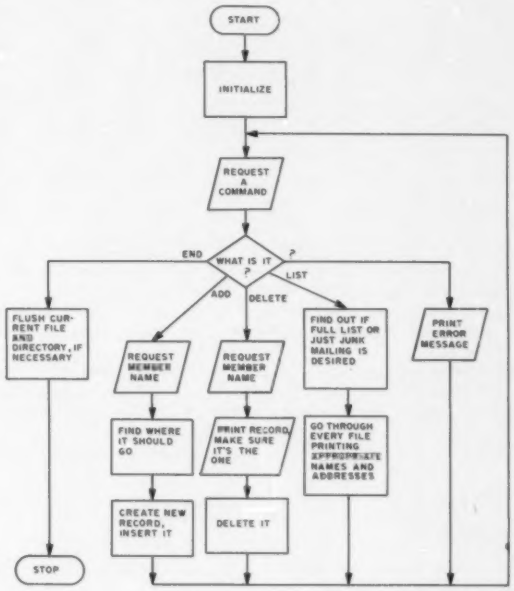
The Main Program

The main program begins by declaring the arrays to store membership records (exactly the same as last time) and the arrays which hold information about each file (i.e., the directory information). The next step is to initialize a number of the variables which we'll use to minimize the number of tape operations required. Also, there is a variable which you'll have to tailor to your own system: R1, which tells how many records can fit in memory at once.

The next thing the program does is determine how to initialize the directory information. If this is the first use of the system ever, there is no directory tape yet, so the program fills zeros into the appropriate parts of the directory, and gets ready to start creating the first file (which will eventually be stored on cassette tape number 1). If, on the other hand, the system *has* been used before, there will be a tape with the directory information on it, and the program requests the user to mount it and read it in.

Next, the program offers to print a summary of the available commands (that's handled by the subroutine which starts at statement 3000, which we'll get to soon).

Finally, the program enters the main loop (starting at statement 2000) which asks for a COMMAND, interprets it, and carries it out. The program segment for the END command begins at statement 2040, the code for the LIST command begins at 2200, the ADD at 2450, and the DELETE at 2570. If the user types in an invalid command, control passes to state-



Command	Action Taken
END	End of run. If the file currently in memory has been altered in any way, write it out to its cassette tape. If the directory has been altered, write it out also.
ADD	Insert a new record. Ask for the new member's name, figure out what file it goes on. If that file isn't in memory, get it. Get the rest of the member information and insert the new record in alphabetical order.
DELETE	Remove a record from the library. For safety's sake, print the whole record and ask again before deleting it.
LIST	Generate a mailing list. Go through the entire library, starting with tape file 1, printing names and addresses of appropriate members.

Fig. 2. Basic structure of the record-keeping program with each command described.

ment 2750.

The statements which handle the commands make frequent use of subroutines to carry out the details. As you go over the statements, keep referring to the flow chart in Fig. 2 to see how things fit into the overall scheme. Incidentally, even if you have no plans whatsoever to implement this program on your own machine, you'll learn a lot by making sure you see how the program works, and by trying to redo parts of it in different ways, seeing if you can make it cleaner and more useful. (I'm happy with it the way it is, but everyone's taste and specific needs differ.)

```
1000 REM  FILE MANIPULATION PROGRAM
1010 REM  THIS PROGRAM MAINTAINS A "DATA BANK"
1020 REM  OF CLUB MEMBERSHIP RECORDS ON A LIBRARY
1030 REM  OF CASSETTE TAPE FILES.
1040 REM  EACH FILE CONSISTS OF UP TO "R1" RECORDS,
1050 REM  AND IS MAINTAINED IN ALPHABETICAL ORDER.
1060 REM  EACH RECORD HAS 6 FIELDS:
1070 REM        NS$ :  IS THE MEMBER NAME FIELD
1080 REM        AD$ :  IS THE STREET ADDRESS FIELD
1090 REM        CS$ :  IS THE CITY, STATE, ZIP FIELD
1100 REM        DS$ :  IS THE DUES EXPIRATION DATE
1110 REM        SD$ :  IS THE SYSTEM DESCRIPTION FIELD
1120 REM        LS$ :  IS THE MAILING LIST PREFERENCE
1130 DIM NS(R1),AD$(R1),CS$(R1),DS$(R1),SD$(R1),LS$(R1)
1140 REM  THE DIRECTORY CONSISTS OF
1150 REM        R0 = THE TOTAL # OF RECORDS
1160 REM        T0 = THE TOTAL # OF FILES
1170 REM        F$( ) = THE NAME FIELD OF
1180 REM                THE FIRST RECORD ON EACH FILE
1190 REM        G1 ( ) = THE # OF RECORDS ON EACH FILE
1200 DIM F$(25),G(25)
1205 REM  "T" IS THE TAPE FILE CURRENTLY IN MEMORY
1210 REM  T1=1 IF THE FILE IN MEMORY HAS BEEN ALTERED.
1220 LET T1=0
1230 REM  R1 IS THE MAX # OF RECORDS PER FILE
1240 LET R1=15
1250 REM  IF FIRST USE EVER, INITIALIZE DIRECTORY, ETC.
1260 PRINT "IS THIS THE FIRST USE OF THIS SYSTEM"
1270 INPUT Z$
1280 IF Z$ <> "YES" THEN 1300
1290 REM  FIRST USE, NO RECORDS YET, DIRECTORY ALTERED
1295 LET R0=0
1310 LET D1=1
1320 REM  GET READY FOR FIRST FILE
1330 LET T0=1
1340 PRINT "PLEASE MOUNT A NEW TAPE, BUT DON'T RUN IT"
1350 PRINT "IT'S TAPE FILE NUMBER 1."
1360 LET T=1
1370 LET G(T)=0
1380 GO TO 1560
1390 REM  NOT FIRST USE, GET DIRECTORY
1400 PRINT "PLEASE MOUNT AND RUN THE DIRECTORY TAPE."
1410 REM  CALL MACHINE LANGUAGE ROUTINE TO SET
1420 REM  UP TAPE READ OPERATION.
1430           (call goes here)
1440 INPUT R0, T0
1450 FOR F3=1 TO T0
1460    INPUT F$(F3),G(F3)
1470    NEXT F3
1480 REM  CALL MACHINE LANGUAGE ROUTINE TO
1490 REM  TURN OFF TAPE READ OPERATION.
1500           (call goes here)
1510 REM  NO FILE IN MEMORY, DIRECTORY UNALTERED.
1520 LET T=0
1530 LET D1=0
1540 PRINT "THANKS. YOU CAN REMOVE DIRECTORY TAPE."
1550 REM  OFFER COMMAND SUMMARY.
1560 GOSUB 3000
2000 REM  MAIN LOOP -- GET COMMAND AND DO IT.
2010 PRINT "COMMAND"
2020 INPUT C$
2030 IF C$ <> "END" THEN 2100
2040    REM  "END"  DUMP ALL NECESSARY STUFF
2050    GOSUB 7000
2060    IF D1 <> 1 THEN 2150
2070    PRINT "PLEASE MOUNT DIRECTORY TAPE."
2080    REM  CALL MACHINE LANGUAGE ROUTINE
2090    REM  TO SET UP TAPE OUTPUT.
2100           (call goes here)
2110    PRINT R0, T0
2120    FOR F3=1 TO T0
2130       PRINT F$(F3),G(F3)
2140       NEXT F3
2145    REM  CALL MACHINE LANGUAGE ROUTINE
2146    REM  TO STOP TAPE OUTPUT OPERATION.
2147           (call goes here)
2150    PRINT "THERE ARE "T0" FILES IN THE LIBRARY."
2160    PRINT "CONTAINING "R0" RECORDS."
2170    PRINT "SEE YOU AGAIN."
2180 IF C$ <> "LIST" THEN 2440
2200    REM  MAILING LIST COMMAND.
2210    REM  SERIOUS OR JUNK MAILING?
2220    PRINT "ALL MEMBERS (YES) OR"
2230    PRINT "JUST MAILING LIST (NO)";
2240    INPUT Z$ --
2250    REM  ALREADY HAVE TAPE 1?
2260    IF T=1 THEN 2310
2270    REM  NO, DUMP CURRENT FILE, GET TAPE 1.
2280    GOSUB 7000
2290    LET T=1
2300    GOSUB 6000
2310    REM  PRINT THIS FILE.
2320    FOR I=0 TO G(T)-1
2330       IF Z$="NO" AND LS$(I)="NO" THEN 2380
2340       PRINT
2350       PRINT NS(I)
2360       PRINT AD$(I)
2370       PRINT ES(I)
2380       NEXT I
2390    IF T > T0-1 THEN 2000
2400    GOSUB 7000
2410    LET T=T+1
2420    GOSUB 6000
2430    GO TO 2310
2440 IF C$ <> "ADD" THEN 2560
2450    REM  "ADD" COMMAND.
2460    REM  GET NAME, TAPE, LOCATION.
2470    GOSUB 4000
2480    IF F <> 1 THEN 2510
2490       PRINT "BUT "F$" IS ALREADY HERE!"
2500       GO TO 2000
2510    REM  ADD NEW MEMBER.
2520    PRINT
2530    PRINT "ADDING A NEW RECORD FOR "F$
2540    GOSUB 5000
2550    GO TO 2000
2560 IF C$ <> "DELETE" THEN 2750
2570    REM  "DELETE" COMMAND.
2580    REM  GET NAME, TAPE, LOCATION
2590    GOSUB 4000
2600    IF F=0 THEN 2680
2610       PRINT "UM, "F$" ISN'T HERE ANYWAY."
2620       GO TO 2000
2630    REM  PRINT RECORD TO BE SURE IT'S THE ONE.
2640    PRINT NS(I)
2650    PRINT AD$(I)
2660    PRINT CS$(I)
2670    PRINT ES(I)
2680    PRINT LS(I)
2690    PRINT "STILL WANT TO DELETE IT";
2700    INPUT Z$
2710    IF Z$ <> "YES" THEN 2000
2720    GOSUB 10000
2730    GO TO 2000
2740 PRINT "SORRY, BUT "C$" ISN'T A COMMAND."
2750    GOSUB 2000
2760    GO TO 2000
```

The Command Summary Subroutine

The subroutine which begins at statement 3000 simply prints a summary of the available commands. Depending on your taste, it could be made more extensive, and include such details as how to load and start your cassette tape equipment, how to store the tape files, and so on. On the other hand, if your system will be used only by people who are very familiar with it, the subroutine could be shortened.

```
3000 REM  COMMAND SUMMARY SUBROUTINE
3010 PRINT "WANT A SUMMARY OF COMMANDS";
3020 INPUT Z$
3030 IF Z$ = "NO" THEN 3140
3040 PRINT
3050 PRINT "******* COMMANDS *******"
3060 PRINT "END"      -- BE SURE TO GIVE THIS AS"
3070 PRINT "          YOUR LAST COMMAND!"
3080 PRINT "ADD"      -ADD A NEW MEMBER."
3090 PRINT "DELETE -DELETE A RECORD."
3100 PRINT "LIST      -GENERATE A MAILING LIST"
3110 PRINT
3120 PRINT "NOTE: TO CORRECT OR UPDATE A"
3130 PRINT "MEMBER'S RECORD, 'DELETE' AND THEN 'ADD'."
3140 RETURN
```

One difference from last month's scheme is that there's no longer an UPDATE command for altering a member's record. Since we're now keeping the records in alphabetical order, the UPDATE command isn't as simple as before -- if the spelling of the member name changes, the program would have to remove the old record and insert the changed version of it in the proper place. It seemed simpler to me to just provide a DELETE command and let the user do updates with it. Again, it's a matter of taste. If you feel that you'd rather have an UPDATE command, or you'd like to add some other command, the way the main program is organized makes it easy to do so. For example, suppose you want to add a command called PRINT which asks for a member's name and then prints the corresponding record. All you'd have to do is insert an appropriate test at statement 2750, insert the appropriate statements at that point, and shift the statements which handle illegal commands down to the end, like this:

```
2750 IF C$ <> "PRINT" THEN 2880
2760    REM  "PRINT" COMMAND. GET MEMBER NAME, LOCATION.
2770    GOSUB 4000
2780    PRINT NS(I)
2790    PRINT AD$(I)
2800    PRINT CS$(I)
2810    PRINT DS$(I)
2820    PRINT ES(I)
2830    PRINT LS(I)
2840    PRINT
2850    GO TO 2000
2860 PRINT "SORRY, BUT "C$" ISN'T A COMMAND."
2870    GOSUB 2000
2880    GO TO 2000
```

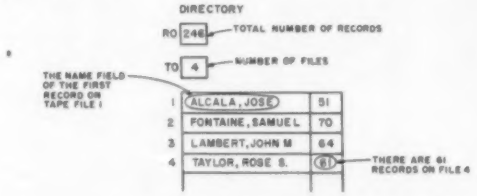
The Get Name, File, and Location Subroutine

This subroutine performs a fairly simple task conceptually -- namely, getting a member's name from the user and then finding where it goes. However, since the right file may not be in memory, it can take a fair amount of thrashing around to accomplish this task.

Getting the member's name is easy, but how do we use the directory to discover which file that member's record should be on? The F$( ) part of the directory gives the first member on each file. We begin by considering file number 1 (the variable T2 stores the number of the tape file we're considering). If there is only one tape file, then we're done -- the member must go on file 1. If there are more, we get to line 4080. If the name we seek comes before the first name on file 2, we're done -- again, the member must go on file 1. If on the other hand, the name we seek

There are two assumptions that heavily influence the design of the record-keeping program. First, I've assumed that (eventually) there will be many more records than will fit in memory at once. If in your particular application that's not true, you can simplify the program substantially (you no longer need the directory, the update procedure, nor any of the elaborate tape requesting and dumping machinations).

The second assumption is that we have only one simple, slow cassette recorder to work with. That means that any extra work the program can do to avoid reading or writing tapes will be well worth the effort. By keeping the records in alphabetical order and by keeping a directory showing where each tape file starts, we can figure out what tape file a particular name goes on immediately, with no extra tape reads. By keeping track of whether or not a file in memory has been altered, we can avoid any unnecessary tape write operations.


DIRECTORY
R0 246
TOTAL NUMBER OF RECORDS
T0 4
NUMBER OF FILES
THE NAME FIELD OF THE FIRST RECORD ON TAPE FILE 1
1 ALCALA, JOSE 51
2 FONTAINE, SAMUEL 70
3 LAMBERT, JOHN M 64
4 TAYLOR, ROSE S. 61
THERE ARE 61 RECORDS ON FILE 4

The directory at a particular point in time.

Other Key Variables:

D1 = 1 if directory has been altered at any time during the current run.

T1 = 1 if the tape file in memory has been altered in any way.

R1 = the maximum number of records per file.

comes *after* the first name on file 2, the test in line 4080 fails, and we add one to T2 and go through the process again. Eventually, either we come to the last tape file (and the test in line 4070 succeeds), or else we find that the name goes before the first name on file T2+1 (and the test in line 4080 succeeds). In either case, when we exit to line 4110, we know that the member belongs on file T2.

Next, the routine checks to see if the right file is already in memory (line 4120), and if not, we flush out whatever file *is* in memory (using the flush subroutine which begins at statement 7000) and request the proper file (using the tape read subroutine — line 6000). At last we have the right file in memory and we can call the search subroutine (line 5000) to determine where the record goes in the file.

```
4000 REM: GET NAME, FIND PROPER FILE AND LOCATION
4010 REM: USED FOR "ADD" AND "DELETE" COMMANDS
4020 PRINT "MEMBER (LAST NAME, FIRST & MIDDLE INITIAL)"
4030 INPUT XS,YS
4040 LET PS=XS+","+YS
4050 REM: WHAT FILE DOES "PS" FIT IN?
4060 LET T2=1
4070 IF T2 > -10 THEN 4110
4080   IF PS < FS(T2+1) THEN 4130
4090   LET T2=T2+1
4100   GO TO 4070
4110 REM: "PS" GOES ON FILE "T2". HAVE IT ALREADY?
4120 IF T2=T THEN 4180
4130 REM: DON'T HAVE IT. FLUSH CURRENT TAPE.
4140 REM:          REQUEST TAPE "T2".
4150 GOSUB 7000
4160 LET T=T2
4170 GOSUB 6000
4180 REM: WHEW! AT LAST WE CAN SEARCH FOR "PS".
4190 GOSUB 5000
4200 RETURN
```

Binary Search Subroutine

The next subroutine is a key one. It's the subroutine that searches the records in memory for a particular member's name (stored in P$). It's different from last time because now we're storing the records in alphabetical order of the members' names. The main reason we're doing that is to minimize the number of tape operations the user has to do. However, there's an added benefit. Our program will be able to look up records much faster than before. Why's that?

Imagine how horrible it would be if the phone company listed people in their phone directory in the order in which they signed up for phones! My phone book has about 72,000 listings in the white pages. Even if I could look at 5 entries per second, it would take *two hours* to find a number, on the average. (That's assuming I didn't go bananas first.) Of course, the phone company has had the good sense to put the listings in alphabetical order, and we all know how to use that fact to enable us to find a number in a few seconds. Quite a difference.

It's easy to see why having the entries in alphabetical order is such a big deal. If they're not, when I look at an entry and it turns out not to be the right one, I've eliminated just that one possibility. On the other hand, if they *are* in order, and I look at an entry near the middle of the phone book, if it's not the right one, I can eliminate 36,000 entries from further consideration by checking whether the name I want comes before or after the one I just looked at.

It's all very well to imagine looking up numbers in the phone book — now we have to devise a computer program that mimics what we do. The key idea seems to be that as we go along, we keep narrowing down the region of the phone book in which the entry must lie. Let's use two variables, one called L (for Low) which stores an array subscript value which we know to be lower than the position of the name we seek, and one called H (for High) that stores a value which is higher than the subscript of the desired element. Then, each time through the loop, we'll look at the array position midway between L and H. If it's the name we're looking for, we're done. If the name comes earlier than the one we just looked at, we'll adjust H. If it comes later, we adjust L. If L and H squeeze together before we've found the name we want, that means that the name wasn't in the array at all, but that it should be at location H. Since each step of this procedure can eliminate half of the remaining possibilities, it's called a *binary search procedure.* Follow through the flow chart in Fig. 3 with a few examples to get a feeling for how it works.

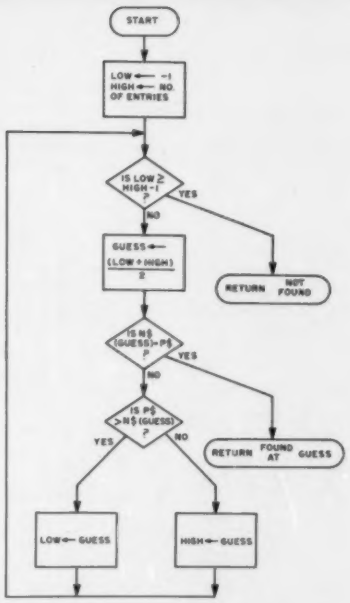


Fig. 3. The binary search procedure.

```
5000 REM: BINARY SEARCH ROUTINE
5010 REM: LOOK FOR MEMBER NAME "PS"
5020 REM: "G(T)" GIVES THE NUMBER OF RECORDS
5030 REM: IN MEMORY (ON FILE "T").
5040 REM:   "L" IS AN ARRAY SUBSCRIPT LOWER
5050 REM:          THAN "PS" & POSIT-ION.
5060 REM:   "H" IS HIGHER THAN "PS".
5070 REM: RETURNS  F=0 NOT FOUND, BELONGS AT "I"
5080 REM:          F=1  FOUND AT POSITION "I".
5090 LET L=-1
5100 LET H=G(T)
5110 IF L > H+1 THEN 5240
5120   LET I=INT((L+H)/2)
5130   IF PS=N$(I) THEN 5210
5140   IF PS > N$(I) THEN 5180
5150     REM: "PS" IS BEFORE "I"
5160     LET H=I
5170     GO TO 5110
5180     REM: "PS" IS AFTER "I"
5190     LET L=I
5200     GO TO 5110
5210 REM: FOUND IT AT "I"
5220 LET F=1
5230 RETURN
5240 REM: IT'S NOT HERE, BUT IT SHOULD BE AT "H".
5250 LET I=H
5260 LET F=0
5270 RETURN
```

Read Tape Subroutine

This subroutine is fairly simple, but parts of it depend on the details of your cassette tape interface. I've assumed that on your system, you can "fool" the BASIC interpreter into accepting input values from tape through INPUT statements. On our system, we dig into the interpreter code and change the I/O port specification used by the routine that handles terminal I/O. After the desired values have been read in from the tape, we switch it back so that further INPUTs come from the terminal.

The sequence of statements from 6080 to 6140 may look a little weird unless you recall that every time BASIC comes to a comma in the input, it assumes that's the end of the value, so that, for example, the comma after the member's last name divides the entire member's name into two separate strings.

```
6000 REM: REQUEST AND READ TAPE "T"
6010 REM: DETAILS OF TAPE READ DEPEND ON
6020 REM: SPECIFIC IMPLEMENTATION
6030 PRINT "PLEASE MOUNT TAPE FILE #";T
6040 REM: CALL MACHINE LANGUAGE SUBROUTINE TO
6050 REM: SET UP TAPE READ OPERATION.
6060         (call @p , base)
6070 FOR I=0 TO G(T)-1
6080   INPUT XS,YS
6090   LET N$(I)=XS+","+YS
6100   INPUT AS(I,1),S(I,2)
6110   LET D$(I)=XS+","+YS+","+Z$
6120   INPUT XS,YS
6130   LET D$(I+1)=XS+","+YS
6140   INPUT S$(I,1),S(I)
6150 NEXT I
6160 REM: CALL MACHINE LANGUAGE SUBROUTINE TO
6170 REM: STOP TAPE READ OPERATION
6180         (call @pop, base)
6190 REM: CHECK TO SEE IF THIS REALLY IS TAPE "T"
6200 IF N$(0)=F$(T) THEN 6230
6210 PRINT "THIS ISN'T TAPE "T". PLEASE CHECK."
6220 GO TO 6000
6230 REM: RESET "TAPE CHANGED" FLAG.
6240 LET T1=0
6250 RETURN
```

Flush Current File Subroutine

If the file that's currently in memory hasn't been changed in any way, T1 will equal 0, and we get away with doing nothing (and the user can just rewind the tape and put it away without waiting for the file to be rewritten). If it has been altered, we copy the new version back to cassette tape for storage using the tape write subroutine. "S2" is a parameter which tells the tape write subroutine where to start from in memory. In the "flush" operation, we want to write the entire file, so we set S2=0.

```
7000 REM  FLUSH CURRENT TAPE SUBROUTINE
7010 REM  IF TAPE 'T' HAS BEEN ALTERED,
7020 REM  THEN REWRITE IT. ELSE DONE
7030 IF T1=1 THEN 7050
7040 '  RETURN
7050 PRINT 'PLEASE REWIND AND RESTART'
7060 PRINT 'THIS TAPE ('T')'
7070 LET S2=0
7080 GOSUB 8000
7090 RETURN
```

Tape Write Subroutine

Like the tape read subroutine, this one is simple conceptually, but depends on your ability to write a machine language program to "fool" the BASIC interpreter. In this case, we want to make the output from a PRINT statement go to the tape machine instead of the terminal. If that's hopelessly messy on your system, you may wind up having to write a machine language routine to handle all the details of memory-to-tape operations. Maybe someday there'll be standards adopted and accepted so we don't have to keep "reinventing the wheel" everytime we want to do I/O!

```
8000 REM  TAPE WRITE SUBROUTINE
8010 REM  WRITE ALL RECORDS FROM 'S2' TO END
8020 REM  CALL MACHINE LANGUAGE SUBROUTINE
8030 REM  TO SET UP TAPE OUTPUT OPERATION.
8040      (soft goes here)
8050 FOR I=S2 TO G(T)-1
8060     PRINT S$(I)
8070     ' (blank)  S$(I)
8080     PRINT S$(I)
8090     PRINT, D$(I)
8100     PRINT, S$(I)
8110     PRINT L$(I)
8120  NEXT I
8130 REM  CALL MACHINE LANGUAGE SUBROUTINE
8140 REM  TO STOP TAPE OUTPUT OPERATION.
8150      (soft goes here)
8160 RETURN
```

Insert New Record Subroutine

This subroutine is used to carry out the ADD command. It, like the search routine, is more complex than last time because we now want the records to be in alphabetical order. If you look back at the main program, you'll see that this subroutine is called after we're sure the right tape file is in memory, and after we've determined where the new record should go in that file (the binary search routine returns the location in memory cell "I"). In order to keep the records in order, we have to shift some of the records already in the file to make room for the new entry.

The old adage "you don't get something for nothing" applies here. Although keeping the records in order lets us look things up faster, it makes inserting a new record slower. With last month's scheme, we just stuck the new records in the next unused location in the arrays. Now we have to move records (half of them on the average) to make room for the new record. The time difference will be barely noticeable compared to the tremendous savings we make by eliminating tape read operations, so we're still miles ahead with our new scheme.

After adding a new record, we need to change the directory and, since we've just altered the file, we have to make sure that T1 is 1 to reflect that fact (see lines 9200 through 9230).

Before we RETURN, there's one more thing we have to check. What if adding this record has completely filled memory? If so, the next ADD command would cause the file to overflow. Since R1 tells how many records are allowed on a file, we see if we've hit the limit in line 9260. Remember that G(T) tells how many records are on file T. If we have, we initiate an update operation by calling the update subroutine.

```
9000 REM  INSERT NEW RECORD AT LOCATION 'I'
9010 REM  CALL SHIFT SUBROUTINE (D=+1 MEANS
9020 REM                SHIFT FROM 'I' UPWARDS)
9030 LET D=+1
9040 GOSUB 11000
9050 REM  GET REST OF MEMBER INFO
9060 LET N$(I)=T$
9070 PRINT 'STREET ADDRESS'
9080 'INPUT A$(I)
9090 PRINT 'CITY, STATE, ZIP'
9100 INPUT X$,Y$,Z$
9110 LET B$(I)=X$+' '+Y$+' '+Z$
9120 PRINT 'DUES EXPIRATION DATE (MONTH, YEAR)'
9130 INPUT X$,Y$
9140 LET D$(I)=X$+' '+Y$
9150 PRINT 'SYSTEM DESCRIPTION'
9160 INPUT S$(I)
9170 PRINT 'MAILING LIST ?(YES OR NO)'
9180 INPUT L$(I)
9190 REM  NOW THERE'S ONE MORE RECORD ON THIS FILE
9200 LET G(T)=G(T)+1
9210 LET R0=R0+1
9220 LET T(T)=1000
9230 LET T1=1
9240 REM  IF THIS FILE IS FULL, INITIATE
9250 REM  AN UPDATE (GROAN)
9260 IF G(T) < R1 THEN 9280
9270 GOSUB 12000
9280 RETURN
```

Delete A Record Subroutine

This subroutine carries out the details of the DELETE command. It uses the shift subroutine to shift all records after the one to be deleted, updates the directory, and notes (by making sure that T1 is 1) that the file has been altered.

```
10000 REM  DELETE RECORD 'I' SUBROUTINE
10010 REM  USE SHIFT SUBROUTINE
10020 LET D=-1
10030 GOSUB 11000
10040 LET G(T)=G(T)-1
10050 LET T(T)=1000
10060 LET T1=1
10070 LET R0=R0-1
10080 RETURN
```

Shift Subroutine

This routine does the shifting required by the insert and delete subroutines. For some reason, it was a real pain in the neck to write. It seems like such a simple thing to do, and now that I've got it working, it looks so reasonable, but ... I wrote it slightly differently at first, only to find that it blew up the first time I did an ADD. The problem was that G(T) is 0 before file T has any records on it, and the way I had written the stupid thing, it tried to access array location -1. I'm sure it demonstrates some Grand Principle about programming, but which one I don't know. Probably some variant of Murphy's Law.

```
11000 REM  SHIFT SUBROUTINE
11010 REM  SHIFT ALL RECORDS BETWEEN 'I'
11020 REM  AND END. DIRECTION DEPENDS ON 'D'
11030 IF D<0 THEN 11060
11040 REM  INSERTING, GO FROM END DOWN TO 'I'
11050 LET J0=G(T)
11055 LET J1=I
11070 GO TO 11110
11080 REM  DELETING, GO FROM 'I' UP TO END
11090 LET J0=I
11100 LET J1=G(T)+1
11110 REM  DO IT
11120 IF J0=J1 THEN 11210
11130 LET N$(J0)=N$(J0+D)
11140 LET A$(J0)=A$(J0+D)
11150 LET B$(J0)=B$(J0+D)
11160 LET D$(J0)=D$(J0+D)
11170 LET S$(J0)=S$(J0+D)
11180 LET L$(J0)=L$(J0+D)
11190 LET J0=J0+D
11200 GO TO 11130
11210 RETURN
```

Update Subroutine

When repeated ADDs have filled up a file, we have to do something about it. The most reasonable thing to do seems to split that file in half and make two tape files out of it. Why does that seem reasonable? Another option would be to add a new tape file at the end of the library, and then spread the records from all the files out evenly. Since that would mean a tremendous number of tape reads and writes if the library was big, I ruled it out (we don't want people sitting around muttering subversive things like "Why don't we up the club dues and get a disk?"). After I had ruled out the second option, I came up with another reason for ruling it out: If a particular file has overflowed, it might be because a lot of club members have names in the same part of the alphabet, so it makes more sense to make more room right around that file than to make a little more room throughout the alphabet.

Since the update yields two tape files where there was one before, and since the tape files themselves have to be kept in alphabetical order for the directory scheme to work right, the user has to

Debugging: Some Tips

The first principle of debugging may seem obvious, but for some reason it gets violated all the time. *You have to know what's supposed to be going on before you can tell what's wrong.* In practical terms, that means that you should have your flow charts, plans, and notes by your side (and you should *use* them) as you try to figure out why the program's responses are wacky, why you're getting that error message, why you feel nervous.

BASIC provides some nice features that aid debugging. It's easy to toss STOP statements at suspect places, and when the program stops there, to use the system in the "console mode" to investigate what's happening.

For example, when I ran into trouble with the shift routine, I typed

```
11125 STOP
```

and ran the program again. When it stopped at 11125, I typed

```
PRINT S0, F0
```

and the system responded

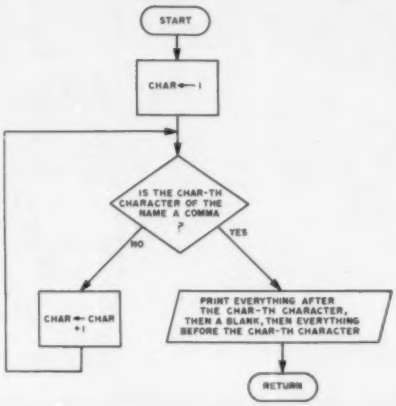
```
-1            0
```

That told me why I was getting the "subscript out of range" error message, but why was S0 starting off at -1?

The important thing at this point, and the thing that takes some discipline, is to resist the temptation to slap in the first fix you can think of that will cure the immediate symptom. You'll be much better off if you take your time, prowl around checking values, figuring out what the real problem is. In this case, it turned out that my whole strategy for shifting was wrong. If I had just changed the statement that set S0 to its initial value, the program would have failed in other situations.

Some Possible Improvements

One added feature that would be worthwhile would be for the LIST command to convert the member names to the "first middle last" form before printing out the mailing labels. Most people would probably rather have their mail addressed to them that way. Your version of BASIC should have built-in string manipulation functions which will make it easy to code this flow chart:


START
CHAR←1
IS THE CHAR-TH CHARACTER OF THE NAME A COMMA ?
NO
YES
CHAR←CHAR +1
PRINT EVERYTHING AFTER THE CHAR-TH CHARACTER, THEN A BLANK, THEN EVERYTHING BEFORE THE CHAR-TH CHARACTER
RETURN

Another problem that could use some work is that the program is totally unforgiving about misspellings. You might find it nicer to have the program check just the first letter of the commands, so that misspellings like the one in the sample run (DELTE for DELETE) wouldn't make any difference. A similar but bigger problem is that if you don't abbreviate a member's name the same way on different occasions, the program will treat each different spelling as a different member. One solution would be to write a subroutine which can tell if two names are "close." It could decide that two names were "close" if the last names were the same and the first names have a lot of letters in common. Then if the user types a name that the program can't find, the program can look for names that are "close" to the one the user wants. If the program manages to find such a name, it should then ask the user if the two names actually refer to the same person.

One last thing: If you're tight on memory, you'll probably benefit by redoing the part of the program that decides when to do an update. If you have the program count the number of *characters* on each file instead of just the number of records, you'll be able to squeeze every last byte out of your memory. Hopefully your version of BASIC has a built-in function that computes the length of a string (it's called LEN in Altair BASIC), which will help greatly.

renumber all the tapes after the one being updated. That's a possible source of error, so anyone who is going to have access to the system should be warned about it. If the tape files *do* happen to get out of order, the tape read subroutine will catch the error (see lines 6190 through 6220), but it might take a number of laborious tape reads to get things working again.

The subroutine should be pretty easy to follow. It copies the second half of the file in memory to the new tape and then updates the directory appropriately. It leaves the rest of the old file in memory, and since it's still file number T, nothing has to be done except to record its new (shorter) length in the directory (line 12240).

```
12000 REM  UPDATE SUBROUTINE
12010 REM  MOVE SECOND HALF OF CURRENT FILE
12020 REM  TO A NEW TAPE, PATCH UP DIRECTORY
12030 PRINT  "THIS FILE IS ABOUT TO OVERFLOW"
12040 PRINT  "GOING TO BE A BIT OF WORK HERE."
12050 PRINT "FIRST, REWIND CURRENT TAPE, IT WILL
12060 PRINT "STILL BE CALLED TAPE FILE "T
12070 LET TO=T0+1
12080 IF T<1+T0 THEN 12120
12090 PRINT "UNFORTUNATELY, YOU MUST RENUMBER"
12100 PRINT "OLD FILES WITH NUMBERS ABOVE "T
12110 PRINT "TO MAKE ROOM FOR A NEW FILE."
12120 PRINT "NOW LOAD A FRESH TAPE, CALL IT 0"; T+1
12130 LET S2=INT(G/T+2)
12140 GOSUB 6990
12150 PRINT "NOW PLEASE TOSS TAPE "T; "BACK"
12160 PRINT "ON THE MACHINE, BUT DON'T RUN IT"
12170 REM  SHIFT ENTRIES IN DIRECTORY TO MAKE ROOM
12180 FOR J=T0+1 TO T+1 STEP -1
12190     LET FS(J+1)=FS(J)
12200     LET G(J+1)=G(J)
12210     NEXT J
12220 LET FS(T+1)=MID$(
12230 LET G(T+1)=S2
12240 LET G(T)=G(T)-S2
12250 PRINT "PHEW!"
12260 RETURN
12270 END
```

Using The System

To use the record-keeping program on your system, you need to copy the statements in the program, fill in the calls to machine language subroutines to do the cassette tape operations, find a good, safe place to store the cassette tapes which hold the directory and files, and let 'er rip! Here's a sample run showing some of the features (I've underlined the parts I entered).

```
Ready
IS THIS THE FIRST USE OF THIS SYSTEM? NO
PLEASE MOUNT AND RUN THE DIRECTORY TAPE
(I did as directed.)
THANKS. YOU CAN REMOVE DIRECTORY TAPE.
WANT A SUMMARY OF COMMANDS? NO
(Surely I know them by now. I said.)

COMMAND? ADD
MEMBER (LAST NAME, FIRST & MIDDLE INITIAL)
? PINSKY, PAUL D
PLEASE MOUNT TAPE FILE #3
(As I did. I remembered if I should have added
    AND RUN IT to that message . . .)
ADDING A NEW RECORD FOR PINSKY, PAUL D
STREET ADDRESS
? 1060 HAMILTON AVE.
CITY, STATE, ZIP
? PALO ALTO, CA. 94303
DUES EXPIRATION DATE (MONTH, YEAR)
? MARCH, 1977
SYSTEM DESCRIPTION
? IMSAI 8080
MAILING LIST (YES OR NO)
? YES
COMMAND ? ADD
MEMBER (LAST NAME, FIRST & MIDDLE INITIAL)
? SMITH, ALVY RAY
ADDING A NEW RECORD FOR SMITH, ALVY RAY
STREET ADDRESS
? 18 GARRONTO LN
CITY, STATE, ZIP
? NOT GIVEN FOR SPEED
DUES EXPIRATION DATE (MONTH, YEAR)
? MARCH, 1980
SYSTEM DESCRIPTION
? ALTAIR 8800A
MAILING LIST (YES OR NO)
? YES
COMMAND? DELTE
SORRY, BUT DELTE ISN'T A COMMAND.
(Guess I was trying to go too fast, grumble . . .)
WANT A SUMMARY OF COMMANDS? NO
COMMAND? DELETE
MEMBER (LAST NAME, FIRST & MIDDLE INITIAL)
? CALDWELL, ERNIE
PLEASE REWIND AND RESTART
THIS TAPE (#3)
(Right. The first part of the alphabet is on tape 1,
    and I just altered tape 3 by doing the ADDs, so
    tape 3 has to be rewritten.)
PLEASE MOUNT TAPE FILE #1
(I did so.)
CALDWELL, ERNIE
2203 POWELL ST.
SANTA CRUZ, CA. 95062
(with 1975
NONE
YES
STILL WANT TO DELETE IT? YES
(We've finally grown up on him.)
COMMAND? END
PLEASE REWIND AND RESTART
THIS TAPE (#1)
(Since I altered the file by making the deletion,
    it has to be rewritten onto the cassette tape.)
PLEASE MOUNT DIRECTORY TAPE
(The directory has been changed too.)
THERE ARE 4 FILES IN THE LIBRARY.
CONTAINING 247 RECORDS.
SEE YOU AGAIN.
```

The only things that aren't demonstrated in the sample run are the mailing LIST option, which prints names and addresses (we cut them out of the listing and use them as address labels), and the update operation, which happens whenever a file gets full.

So that's the record-keeping program. In one sense, it's finished – it works, it does what I wanted it to, it's useful. In another sense, it'll never be finished – as it gets used, inconvenient features come to light; occasionally other ways to organize it enter my mind. I guess the ultimate record-keeping program would be one that did absolutely everything all by itself, from reading the morning mail, to cashing checks, to sending notices to people who are behind in their dues, to keeping me company when nobody is around. That one will have to wait a while.

As The Smoke Clears . . .

Well. We've covered an incredible amount of material in these three articles. Possibly too much. Certainly too much to absorb completely if you really were starting from scratch in Part I. But even if it doesn't all fit together for you yet, I hope the feeling of what it's like to program got across. The feeling that when you actually start doing something, you're in for a struggle at times, some ups and downs. The feeling that to create a finished product you have to keep refining, testing, and revising your plans. No one has ever written even a medium-sized program by just sitting down at the terminal and pounding out lines of BASIC. If that was all there was to it, it wouldn't even be much fun. What I really like about programming is that it involves many apsects of life itself: dreaming, planning, testing, bringing your dreams down to the hard reality of what the machine can do, getting the bugs out, refining your plans, finally seeing your program run, using it, and then starting to dream about the next grand scheme. It's great! ■

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CPU
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DUAL AUDIO CASSETTE
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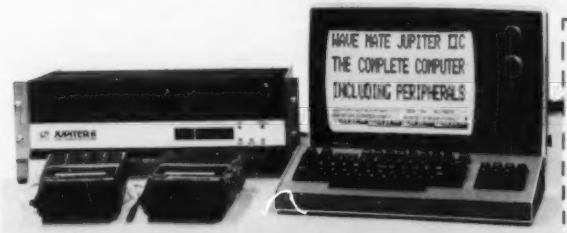
VIDEO TERMINAL INTERFACE
64 x 32 lines
Upper and lower case, plus Greek alphabet; 7 x 12 format, 128 dot (hor.) x 96 dot (vert.) graphics

MEMORY
8K dynamic RAM; 3K ROM; 1K dual-port static RAM

KEYBOARD
Generates full 128-character ASCII set



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Getting By the Friden-8800 Communications Gap

-- interface made easy

Recently, a number of Friden keyboard-printers and associated controllers have appeared on the surplus market. This article is concerned with the TM 20K714 keyboard-printer and its companion TM 20K715 controller, which, in combination, formed the heart of the Burroughs 9350-2 Communications Terminal. While these are certainly impressive looking units, hobbyists have been experiencing difficulty in getting them "on-line" with their home computer systems. This article describes the hardware modifications and the software which were implemented to overcome the communications gap which existed between my 8800 and the asocial Friden.

Photo by Doug Wood

The Altair/Friden system. The 8800 is sitting next to the Friden TM 20K714 keyboard-printer. The TM 20K715 controller (without its cover) is visible under the table.

Hardware

Hardware modifications to the 8800 and the Friden's control unit are relatively straightforward.

The input and output of the controller is RS-232-B compatible. In this configuration, the resting, mark, or logic 1 condition is more positive than +3 volts and the space or logic 0 condition is more negative than -3 volts. The EIA serial interfaces, which are being used by most hobbyists, conform to RS-232-C specs. This configuration defines the logic 1 condition as more negative than -3 volts and the logic 0 condition as more positive than +3 volts. Consequently, for 150 baud serial transmission to and from the Friden it is necessary to invert the polarity of the transmitted and received data signals.

Due to the fact that I have a Processor Technology 3P+S interface, the parts necessary to invert the signals already existed on the board (see Fig. 1). Pin 25 (the "Tx Out" of the UART) was connected as usual to the appropriate gate of IC5, which provides the RS-232-C output. The output of this gate was connected back to the input of a second gate of IC5. The output of this second gate now provided the appropriate polarity signal for transmission to the terminal, i.e., the output signal now conformed to RS-232-B specs as a result of

the additional inversion provided by the second gate. In order to receive data from the Friden, two gates of IC10 on the 3P+S were similarly cascaded. The additional inversion provided by the first gate makes the Friden's RS-232-B transmitted signal appear as RS-232-C to the second gate. The output of this second gate is connected to pin 20, the "Rcv In" of the UART.

For those of you who have other I/O interfaces, all that is required is to connect an inverter (such as a TTL NOR gate) between the data pins of the UART and whatever circuitry (be it transistor or IC) which presently boosts the I/O signals to the RS-232-C level. By inserting the inverters between the UART and the existing circuitry, you will invert the data signals and still maintain the RS-232 drive levels. Such would not be the case if the TTL inverters were external to the existing circuitry.

The only other hardware modification required is at the 25-pin connector of the Friden's controller. Tie pin 5 (Clear to Send Line) to pin 20 (Terminal Ready Line). With pin 5 positive and the ON-LINE switch activated, the orange ON-LINE light will be illuminated, confirming the status of the Friden. The Friden is now capable of transmitting to, and receiving from, the 8800.

To help clarify the logic of the software routines which I developed, it is beneficial to examine the terminal's transmission and reception procedures.

Keyboard Transmission Procedure

To transmit from the keyboard, assuming the terminal is operating properly "on-line," the operator presses the TRANSMIT key. This initiates the transmit mode, lights the TRANSMIT and SEND lamps, unlocks the keyboard, and causes the transmission of an STX character to occur. The operator may then enter a block of data, terminating it by pressing the ETB or ETX key. (Data are provided to the line as keyed, and also stored in the terminal's buffer for possible later retransmission.) For simplicity's sake, we will not make use of this retransmission feature. Following transmission of the ETB or ETX character, the SEND lamp then turns off and the terminal generates a Longitudinal Redundancy Check (LRC) character, which it also sends down the line to the computer. The terminal then waits for an ACK status character from the computer. If this is received when the transmission was terminated by an ETB, the terminal is cleared, the keyboard unlocks, and the SEND lamp comes on. The last block of a transmission should be terminated by an ETX character. Now, following reception of an ACK character by the terminal, the TRANSMIT lamp goes out and the terminal returns to the idle mode.

A conventional input routine will readily accept data from the Friden. Since instances of these are common, I will not get into a description of one here. However, a few suggestions concerning the routine are in order. You may choose to have the routine ignore the STX character, since it is not a piece of valid data with reference to your text. However, the routine should recognize the ETB/ETX characters as flags, and upon their detection send an ACK to the Friden. Your input routine should also ignore the terminal generated LRC character; like the STX, it is not relevant to the actual text being transmitted. You could use a routine, similar to the one presented later, which will use the LRC for detection of transmitted errors, but it is not necessary for the input routine. (As you will soon see, the LRC character plays a major role in outputting data to the Friden.) Note that it is important (necessary) to reply to transmissions from the Friden by sending back the ACK character; otherwise, the keyboard will remain locked up and the TIME-OUT and ERROR lamps will come on. Keep in mind that the Friden's buffer has a maximum capacity of 150 characters before the OVERFLOW light comes on.

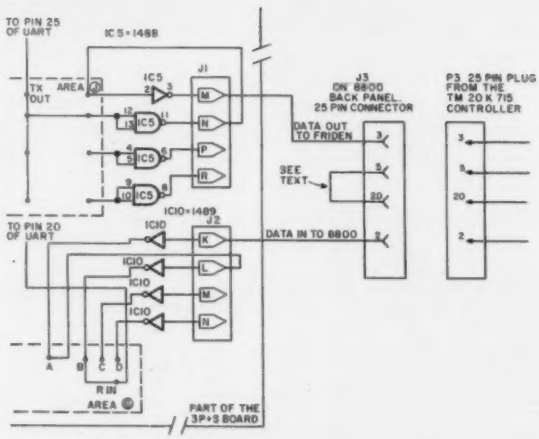

Fig. 1. The interconnection between the Friden's TM 20K715 controller and the Processor Technology 3P+S interface. Note the cascading of the top two gates of IC5 and IC10, to provide the necessary inversion.

Printer Reception Procedure

When the terminal is neither transmitting nor actively receiving, it is in an idle mode. Message reception begins with the detection of an STX character from the computer. As characters are received, they are placed in the Friden's buffer. Upon reception of an ETB/ETX character, the terminal generates an LRC character and looks for an identical LRC character to be sent down by the computer. If no LRC errors have been detected, the terminal transmits an ACK character to the computer and commences to print the contents of its (the terminal's) buffer. The terminal resets the green RECEIVE lamp and returns to the idle mode following reception of the ETX character.

The software presented below causes the 8800 to simulate the transmit conditions which existed at the Burroughs B3501 (the Friden's host computer). As can be seen, the requirements necessary to make the Friden accept data from the 8800 are much more stringent than the conditions required to make the Friden "talk" to the 8800.

The Software

For explanatory purposes, the program is divided into two main routines: BUFFIN and PRINT. BUFFIN is called up by the output routine of my MONITOR program. (Any general output routine can be used to call BUFFIN.) In my system, as the MONITOR outputs data the characters are displayed on a CRT display and stored in a buffer area in the 8800's memory, for eventual transfer to the buffer of the Friden. When a CR character is detected, BUFFIN calls up the PRINT routine. PRINT is responsible for the actual transfer of data from the buffer in the 8800 to the Friden's buffer, and for the generation and transfer of the "handshake" characters described previously. BUFFIN and PRINT will not interfere with the outputting of data to the

CRT display, other than causing a 4 to 7 second delay at the end of a CR-terminated line. This time is consumed by the 8800 transferring data from its buffer to the Friden's buffer, and for the detection of the Friden-generated ACK flag.

Use has been made of memory storage and the stack, to save the status of some of the registers which are redefined when BUFFIN and PRINT are called. The data are assumed to reside in register B prior to calling BUFFIN. The program, as presented, resides in the top 1K of my 9K memory; when you relocate it, pay close attention to the memory references. Nothing can make you wish you had taken up another hobby faster than having to track down an errant memory reference.

As you study the program,

BUFFIN	Pg. 041-100	345	Push H	Save main mem pointer
	101	041	LXI H	Initialize buffer pointer
	102	200		
	103	041		
	104	160	Mov M,B	Store char in buffer
	105	170	Mov A,B	Move char to Acc.
	106	376	CPI	
	107	015		Is char a CR?
	110	312	JZ	Yes, go to
	111	121		GOTCR
	112	041		
	113	043	INX H	No, increment pointer
	114	042	SHLD	store buffer pointer (H&L registers)
	115	102		in address 102
	116	041		pg. 041
	117	341	POP H	Retrieve main mem pointer
	120	311	RET	Return to calling routine
GOTCR	121	041	LXI H	Set buffer pointer
	122	200		To beginning address
	123	041		of buffer
	124	042	SHLD	Store buffer address
	125	102		in address 102
	126	041		pg. 041
	127	000	NOP	no operations
	130	000	NOP	helpful in debugging
	131	000	NOP	ditto
	132	000	NOP	ditto
NEXT	Pg. 041-133	106	MOV B,M	Get char from buffer
	134	315	CALL	Call up
	135	000		the location of
	136	042		the PRINT routine
	137	176	MOV A,M	Move char to Acc.
	140	376	CPI	
	141	015		Is char a CR?
	142	312	JZ	Yes, last char
	143	151		in buffer, go to
	144	041		LAST
	145	043	INX H	Increment pointer
	146	303	JMP	No, fetch next
	147	133		char in buffer
	150	041		by going to NEXT
LAST	151	041	LXI H	Initialize buffer
	152	200		for next pass
	153	041		
	154	042		Store buffer address
	155	122		in address 122
	156	041		pg. 041
	157	341	POP H	Retrieve main mem pointer
	160	311	RET	Return to main calling routine
PRINT	Pg. 042-000	076	MVI A	Test for first
TS 1	001	002		call of PRINT
	002	376	CPI	during this
	003	002		pass
	004	314	CZ	Yes, go to
	005	030		OUTSTX
	006	042		
	007	315	CALL	No, output the
	010	050		present character
	011	042		
	012	315	CALL	Generate the
	013	070		LRC character
	014	042		
	015	170	MOV A,B	Is present
	016	376	CPI	character A
	017	015		CR?
	020	312	JZ	Yes, dump
	021	100		the terminal's
	022	042		buffer
	023	311	RET	No, return to BUFFIN
	024	000	NOP	No operations
	025	000	NOP	helpful in debugging
	026	000	NOP	ditto
	027	000	NOP	ditto
OUTSTX	Pg. 042-030	170	MOV A,B	Store present
	031	062	STA	character in
	032	046		Temporary Storage 3
	033	042		
		034	006	MVI B
		035	002	
		036	315	CALL
		037	050	routine
		040	042	
		041	075	DCR A
		042	062	STA
		043	001	in Temporary Storage 1
		044	042	for future reference
		045	006	MVI B
	TS 3	046	xxx	Temporary Storage 3
		047	311	RET
	OUTIT	Pg. 042-050	333	IN
		051	006	control channel
		052	346	ANI
		053	200	Ready?
		054	312	JZ
		055	050	
		056	042	
		057	170	MOV A,B
		060	323	OUT
		061	007	terminal
		062	311	RET
		063	000	NOP
		064	000	NOP
		065	000	NOP
		066	000	NOP
		067	000	NOP
	GENLRC	070	356	XRI
	TS 2	071	000	Store the result
		072	062	STA
		073	071	in TS 3 for
		074	042	future reference
		075	311	RET
		076	000	NOP
		077	000	NOP
	DUMP	Pg. 042-100	006	MVI B
		101	003	an ETX character
		102	315	CALL
		103	050	ETX to
		104	042	the terminal
		105	315	CALL
		106	070	LRC character
		107	042	for this pass
		110	107	MOV B,A
		111	000	NOP
		112	315	CALL
		113	050	
		114	042	
		115	000	NOP
		116	000	NOP
		117	000	NOP
	ACKIT	120	333	IN
		121	006	control channel
		122	346	ANI
		123	001	Ready?
		124	312	JZ
		125	120	
		126	042	
		127	333	IN
		130	007	data channel
		Pg. 042-131	376	CPI
		132	006	Is it an ACk
		133	302	No, Loop
		134	120	
		135	042	
		136	076	MVI A
		137	002	entrance to detect
		140	062	STA
		141	001	of next pass
		142	042	
		143	076	MVI A
		144	000	character address
		145	062	STA
		146	071	
		147	042	
		150	311	RET

Table 1. Altair/Friden interface routines.

it will become apparent that the main calling routine could call PRINT directly, circumventing BUFFIN. You may elect to do so. However, if you use the Friden to get hard copy while you are getting soft copy on a CRT, you may have problems. Some programs, such as those for games, may only output half a line; they may then wait for an operator response before finishing the line and generating the CR character. This is OK on a CRT display, where printout is instantaneous (well, almost instantaneous) and not being timed. But remember that the Friden has a 25 second timer which starts with the reception of the STX character. If the ETB/ETX and LRC characters are not received in the 25 second interval, a TIME-OUT-ERROR condition will be displayed. Consequently, the Friden's buffer will be cleared and no printout will be obtained. Use of BUFFIN ensures the existence of a CR character in the 8800's buffer, and the generation of the all-important ETX and LRC characters by PRINT, within the timed interval. Alas, this is one shortcoming of this configuration of the Friden; it isn't particularly suited to interactive work.

Conclusion

Well, there it is. It isn't the most efficient program, memory-wise. (I don't profess to be a programmer.) But it does work, and the Friden produces a hard copy with a style all its own. Before configuring it to your system, be certain that you understand "everything" in the program. I wouldn't want to see anybody have to put the days (and sleepless nights) into this project which I put into it. Actually, it was fun, but it had its moments.

Good luck with it. If you have any difficulties, send an SASE and I will try to help you out. Keep on computing! ■

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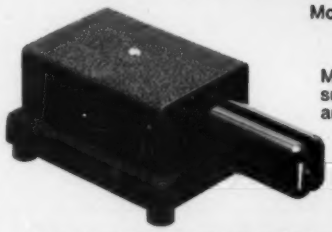

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BLD 2/60	220-230MHz	FM CW/FM	2W	60W
BLD 10/60	220-230MHz	CW/FM	10W	60W
BLD 10/120	220-230MHz	CW/FM	10W	120W
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BLE 2/40	420-450MHz	CW/AM/SSB/FM	30W	40W
BLE 30/80	420-450	CW/AM/SSB/FM	10W	80W
BLE 10/80	420-450			80W

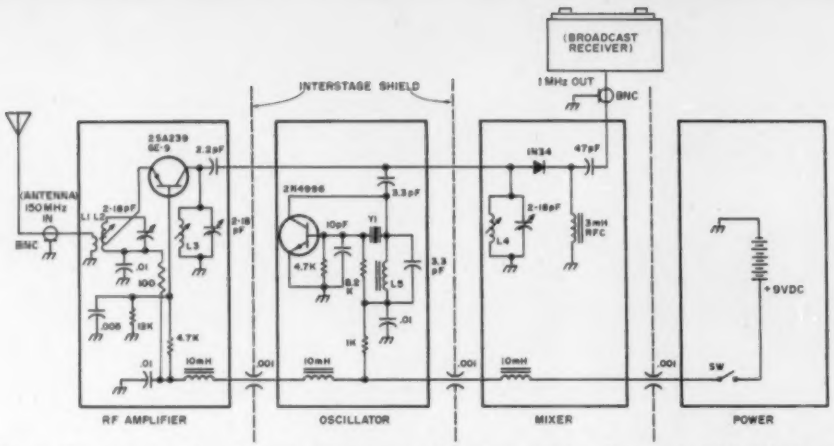

Fig. 1. Two meter to broadcast band converter. L1: 2 turn link on low end of L2. L2: 4 turns #20 on 7 mm slug-tuned form spaced to 5 mm; tap at 1½ turns from low end. L3, L4: 3 turns #20 on 7 mm slug-tuned form spaced to 5 mm. L5: 20 turns #30 closewound on 4 mm solid ferrite form. Y1: 48.5 MHz third overtone crystal, HC25/U holder (see text).

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Another converter? Well, maybe there have been an awful lot of converter designs published in these pages, but take a careful look at this one before you say you don't need a converter. The unit described here is designed to let you tune a 1

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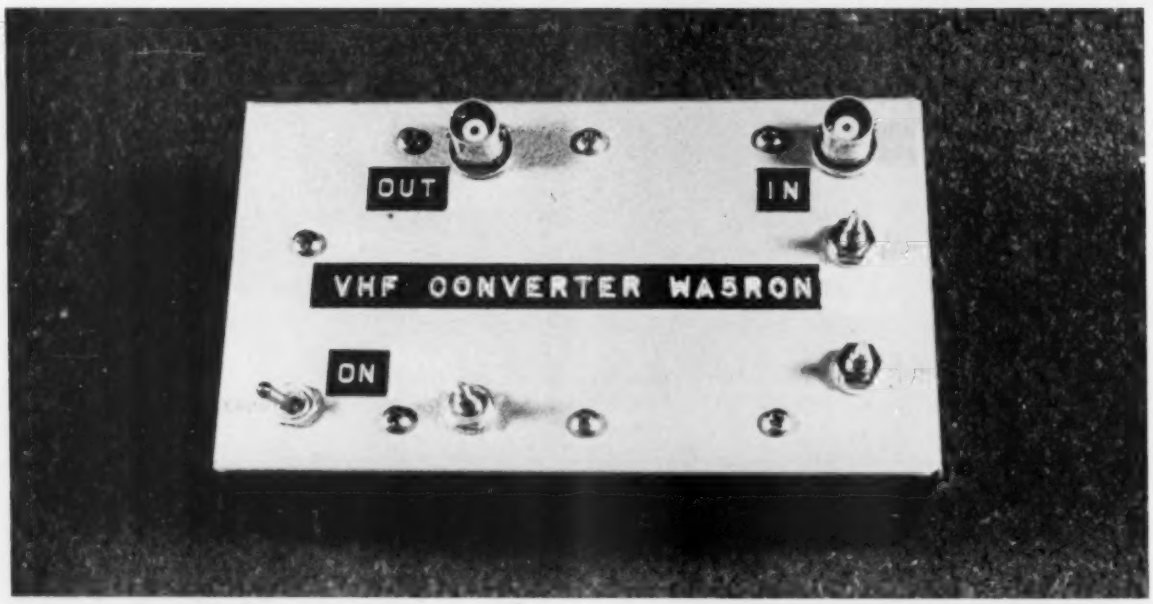
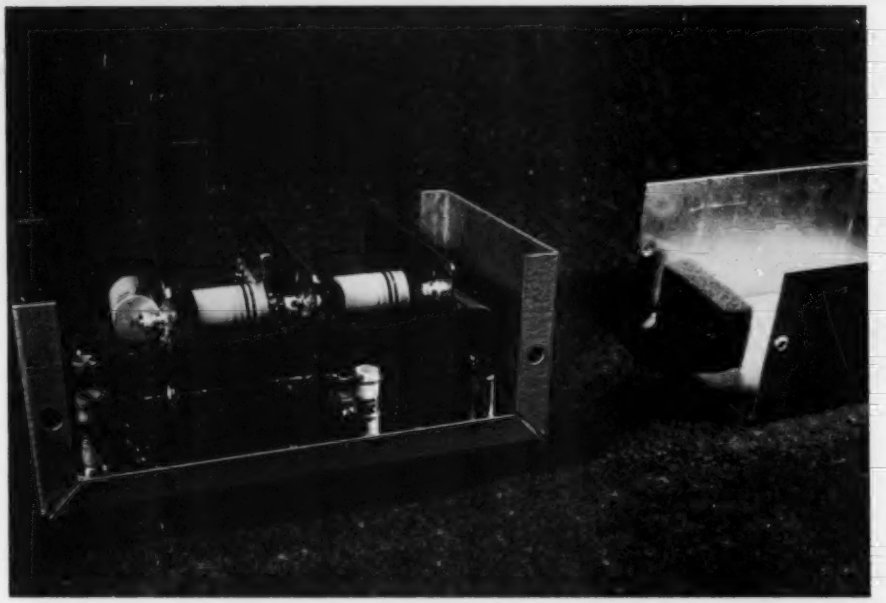


MHz band on two meters using your automobile radio. Even if you already have VHF gear in your car, chances are that you can only receive at a few crystal frequencies, and you would appreciate being able to tune the band to see what is going on. You could also use this converter in a rented car, your wife's car, or for one way communication when traveling with other (non-radio equipped) vehicles on the road. I suppose that you could even build it for the police frequencies or other VHF services.

I thought of building this converter one day when I noticed the push-button AM radio mounted nicely in the instrument panel of my automobile, and realized that it had not been turned on for at least two years (if you reside in Texas but don't like cow music, the AM broadcast band has little to offer). I thought how nice it would be if the coverage of that receiver were in one of the ham bands instead of 300 meters, and I decided right there to build a converter.

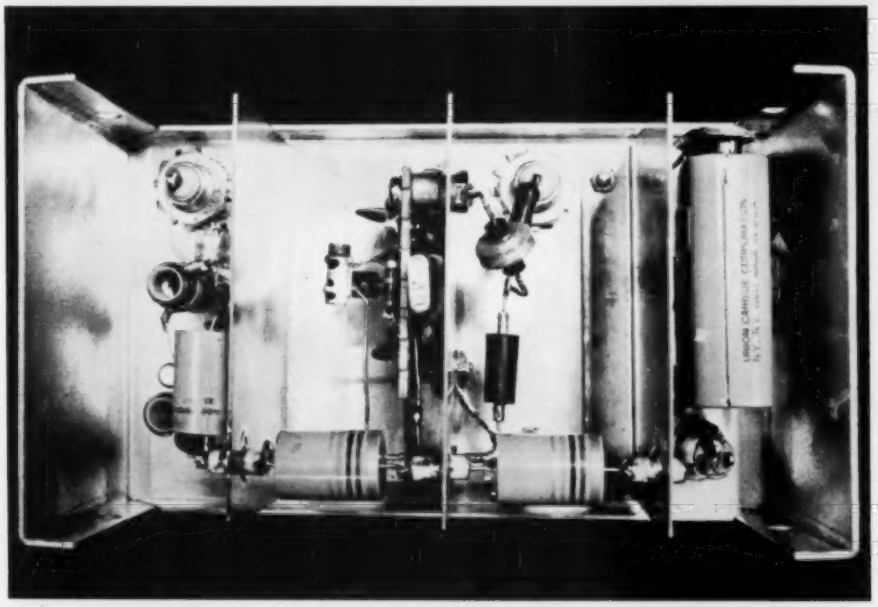
I found a simple converter design in an issue of 73[1], and quickly built one up as in the article. The unit worked, a two meter QSO on one of the repeaters was heard, but it was competing (and losing) with all the 50 kW cow stations that were there, hardly attenuated at all by the converter in the antenna line. It appeared to me that any converter I built to work into the broadcast band as an i-f would have to have considerable isolation between input and output, and that at least one stage of rf amplification ahead of the converter was certainly desirable. The design that evolved is noteworthy in its attention to shielding, compartmentalization, and rf blocking along the power lead, considerations that are necessary in preventing the bleed-through of broadcast stations. Fortunately, automobile radios are already well shielded and bypassed, and they make sensitive i-f receivers with plenty of audio output.



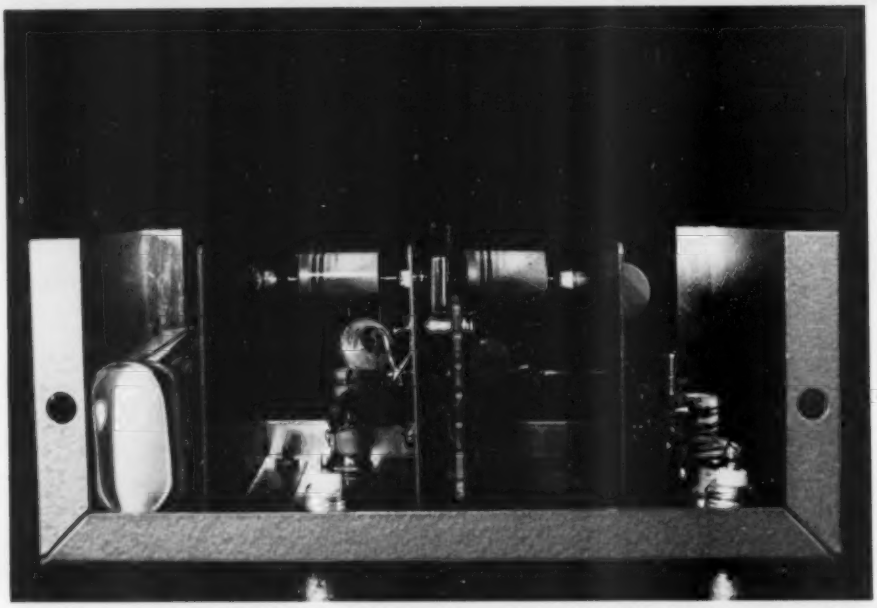
Converter interior is divided by copper shields into four compartments. Block of foam-rubber glued to case half keeps the battery in its clip on bumpy roads.

A 5.5 x 7.5 x 13.5 cm Bud minibox was divided into four compartments by shields cut from sheet copper (hobby or arts and crafts shop). A .001 uF feedthrough capacitor is mounted in each of these shields to pass (and bypass) the power lead, and two of the shields are also fitted with an insulated feedthrough (a grommet will do) for rf. The four compartments contain preamp, oscillator, mixer, and power supply. This last is a 9 volt battery that will run for a long time at 25 mA drain, providing you remember to turn the unit off when not in use.

The preamp is a non-FET design found in Japanese VHF receivers, with a link-coupled input circuit added to discourage the beastly broadcast band from getting deep into the converter. If you don't have a 2SA239 lying around, then any of the



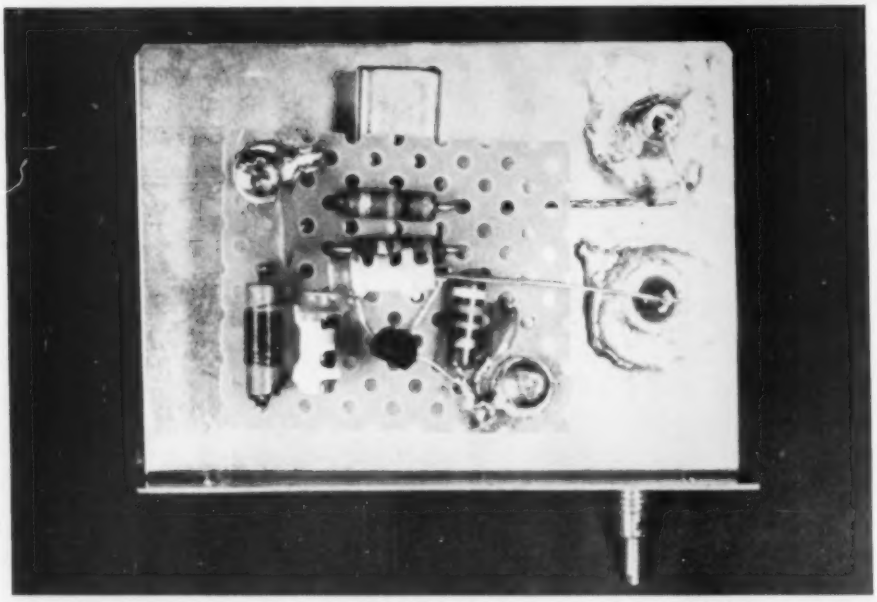
Converter sections are (left to right): 1 — Input and rf amplifier stage, 2 — Crystal controlled oscillator, 3 — Mixer stage and output, 4 — Battery and switch.



Shielding and separation of input and output sections, plus elaborate bypassing of low frequency signals on both rf and power leads is necessary to keep powerful broadcast stations from shoving their interference through the converter.

"equivalent" transistors they sell nowadays in the wholesale stores should work. I tried a GE-9 and it did just fine. Component leads must be very short or they will add inductance in series with the coils, which are quite small. Ground points can be soldered directly to the copper shield.

The oscillator was wired together on a small piece of vectorboard, held by machine screws and short standoffs to the copper shield. The oscillator stage was put between amplifier and mixer to maximize the physical separation between input and output. A third overtone crystal in the 48-49 MHz range is employed, giving a third harmonic at two meters that is used by the mixer stage. Choose a crystal frequency such that when multiplied by three, the resultant frequency is 600 kHz below the bottom of the range you would like to tune. For example, if you wish to tune the popular FM frequencies between 146 and 147, a crystal near 48.4667 could be selected. The third harmonic would be 145.4, putting 146 at the 600 kHz mark, and 147 at 1600. This should be fine for locating repeaters in unknown towns as you travel about, or just keeping tabs on local FM activity. If you would like to preserve the usefulness of the original dial calibrations, then you need a crystal cut for 48.6667 (146.0). This will put 146.55 MHz at the little "55" on the dial, and 147.6 will come in at "160" or "16" or whatever you have at the top end. When you order a crystal, include a drawing of the oscillator schematic, and tell the manufacturer what third harmonic frequency you want to get, as well as the 48 MHz third overtone frequency.



The oscillator board mounted on one side of a shield. Crystal socket and miniature crystal are the only components on the backside of the board. Power feedthrough capacitor is at upper right and insulated feedthrough for the rf line is below. Mixer stage (part of coil visible at bottom) is on the reverse side of shield.

You will note that the tuned circuits in this converter have both variable capacitors and slug-tuned coils. This allows one to roughly peak the circuits using the capacitors with the box open, and then fine tune all stages after the unit is closed up and mounted in the vehicle. Cut a length of antenna cable to go between converter and radio, with a Motorola plug on one end and a BNC on the other. The car's telescoping whip antenna will work just fine when pushed down to quarter wavelength, and if the feed line is replaced with RG-58 or RG-59. The original automobile antenna cable seems to be some sort of cheapo shielded stuff with a kinky wire for a center conductor. I suspect that it was not intended for VHF, and certainly not very good for transmitting.

Many new cars seem to come with a solid steel whip. This could be used as is, but cutting it to quarter wavelength will improve VHF

reception and broadcast image rejection. I can't recommend those imbedded-in-the-windshield type antennas at all. This novelty was foisted on the car buyer at about the same time as the something-else-to-malfunction hideaway headlight. If you got stuck with one (or both) of these, you might as well punch a hole and mount a decent two meter antenna. After all, you are a ham, aren't you?

Plug the converter in and tune up the circuits on a signal somewhere near the middle of the band. Look for the antenna trimmer capacitor on the broadcast radio and tune for maximum signal reception. This capacitor may be found near the antenna input connector, or behind a hole above the tuning shaft that can be reached by pulling a knob (instead of pulling the whole radio). This adjustment does make a difference.

My little converter should give you good reception on two meters of both AM and FM stations. The ability of the automobile radio to slope-detect FM depends upon the sharpness of its i-f tuning. I found that I was able to improve the tuning and tracking across the band of both i-f and rf stages within the receiver by tweaking on the slugs. Getting the radio out and back into most modern automobiles is made easier by turning the vehicle upside down and moving the firewall forward a few feet.

You might even go so far as to cut into the original AM board and add one of the FM limiter and discriminator integrated circuits. I think that you will find, however, that FM reception is quite acceptable without any modification to the broadcast receiver. ■

Reference

[1] "Build the OTC," John Crawford WA4SAM, George Webber W1DVG, *73 Magazine*, January, 1966, page 74.

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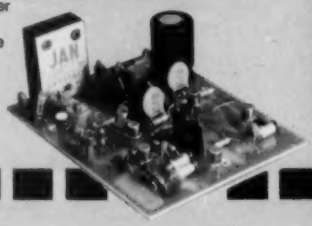

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Frequency measurement has always been an expensive problem for the radio amateur; the least expensive frequency counter costs about $150. Frequency measurement by counting is not the only method of measurement, however. Another less expensive, and equally accurate, alternative for specific applications is called frequency comparison. This article will describe a crystal calibrator/comparator for SSTV that will permit adjustment of various SSTV frequencies to within 1 Hz for as little as $20. The calibrator can either be built into the Robot Research 80A camera, or implemented as a self-contained unit for an additional $10.

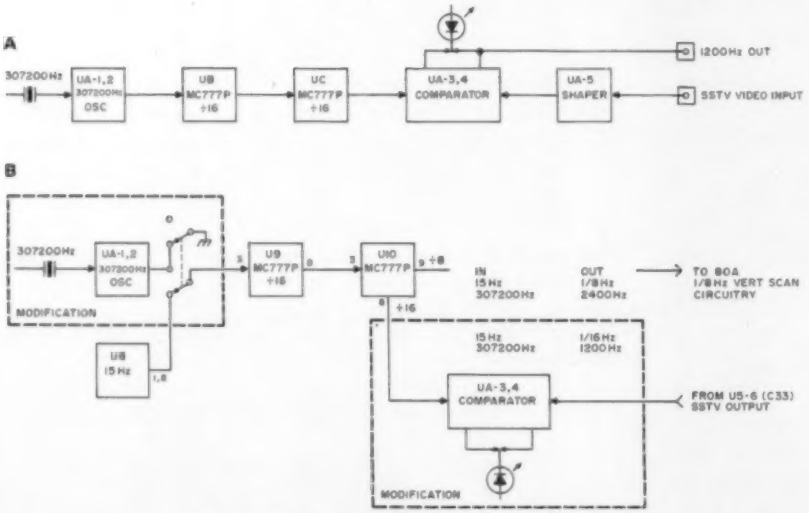


Fig. 1. Overview of crystal clear 1200 Hz.

Overview

The basic requirement in any frequency comparison system is an accurate frequency source. One such source is a crystal oscillator in the 1200 Hz to 2300 Hz range. Crystals in this frequency range are somewhat difficult to fabricate; however, crystals in the 256th multiple of this range (300 kHz – 600 kHz) are easily obtained. All that is required is a division by 256, and a frequency comparator.

In both the 80A and self-contained versions (Fig. 1), a crystal controlled square wave generator at 307,200 Hz (1200 Hz x 256) is fed into a 256 divider chain and emerges as 1200 Hz. This 1200 Hz signal is then compared to the 1200 Hz SSTV video. The resultant "beat note" is displayed on an LED (Light Emitting Diode).

In the 80A version, Fig. 1(b), the divider chain in the NORMAL mode is used to convert the 15 Hz horizontal input to a 1/8 Hz (8 second) vertical signal by dividing by 128; the last counting position is not used. In the COMPARE mode, the input to the 256 divider chain is changed to 307,200 Hz and the output at 1200 Hz is taken from the last position. The same "beat note" detector is used. If operation at 2300 Hz is desired, a crystal frequency of 588,800 Hz would be required. Since crystals in this frequency range cost $37.50, a crystal at 1/2 the frequency, 294,400 Hz, costing $13.50 is used, and the output is taken at the divide by 128, the next to the last, divider position.

CIRCUIT DESCRIPTION

The oscillator and comparator are both contained in an RCA CA-3046 5 transistor DIP module.

Oscillator

The oscillator is a standard 2 transistor free-running

multivibrator in which one of the RC networks has been replaced by a crystal. The free-running frequency, originally controlled by the RC networks, is now controlled by a .01% tolerance crystal. The maximum crystal error is 30 Hz at 307,200 Hz. When the frequency is divided by 256, the error, which is also divided by 256, becomes .12 Hz; this is far more accurate than any SSTV requirements. The output of the oscillator is a square wave which when loaded is about 1.0 volts to 1.7 volts at 307,200 Hz. The oscillator was designed to have a minimum loading effect on the +3.6 volt regulated supply (80A). The 80A +3.6 volt supply already has about a 200 mA load, and the regulator transistor is "hot" to the touch.

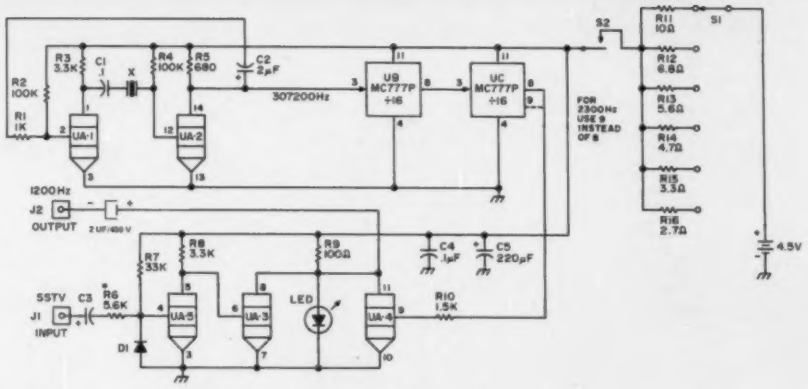


*Fig. 2. Self-contained crystal clear 1200 Hz. U1 – RCA CA3046; U2, U3 – Motorola MC777P; S1 – Archer 2751386; LED – Archer 276-041; S2 – Calectro E2-140; R1-R10 – ¼ W 10%; R11-R16 – ½ W 10%; D1 – Archer 276-612 or 276-114; chassis box – Calectro H4-742; battery holders – 1 cell, Calectro D3062; 2 cell, Calectro D3063. Calectro = Lafayette, Archer = Radio Shack. *R6 was designed for an 80A output greater than 2 V p-p and a low output source impedance. X – see Crystal Specifications.*

Comparator

The comparator is composed of 2 inverters with a common collector load resistor and shunting LED. The LED has a minimum voltage threshold of about +1.2 volts. Current will flow in the LED only when BOTH transistors UA-3 and UA-4 are off. The amount of time that both are off, and in turn the LED is illuminated, depends upon the frequency relationship of the 1200 Hz crystal controlled reference frequency and the SSTV input frequency. As the two signals "beat" together, the LED will "flicker" at the rate of the difference frequency. Since the two signals will rarely lock together at the same frequency, there will always be some flicker. The comparator output when no SSTV video is inputted consists of a 1200 Hz square wave of about 1 volt p-p. This signal, with a very low source impedance, is ac coupled to the output jack, J2, and can be used as a 1200 Hz signal generator.

Divider Chain (Self-Contained Only)

The divider chain in the self-contained version is identical to the one used in the 80A, and consists of two Motorola MC777P binary counters connected in tandem. Since the divider chain counters are unloaded, I found that the most reliable operation was obtained at about +3.2 volts.

Switch (80A only) Fig. 3

Many methods were analyzed in order to find a method of injecting the 307,200 Hz signal into the 80A divider chain without disturbing the land pattern. The only solution found, however, was to "break" the land pattern on the back of the component board as shown in Fig. 4. Leads to the modification can be run from either the land pattern on the back, or touch soldered from the pins of the DIP modules on the front, depending on the skill of the user.

The switch, S1, provides the means by which the 307,200 Hz signal is injected into the divider chain.

Power Supply (Self-Contained Only)

The divider chain, unloaded in this application, works optimally at about +3.2 volts ± .2 volts. The load current is about 150 mA. A power supply could have been constructed for about

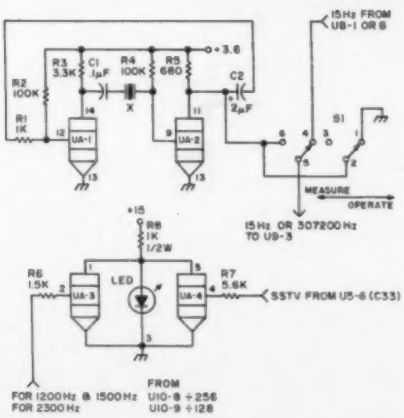


Fig. 3. 80A modification. All resistors except R8 can be as low as ¼ Watt 10%. U1 – RCA CA3046; LED – Archer 276-041; S1 – Calectro E2-105; C2 – Calectro A1-125; X – see Crystal Specifications; term strip – Calectro F3214. Calectro = Lafayette, Archer = Radio Shack.

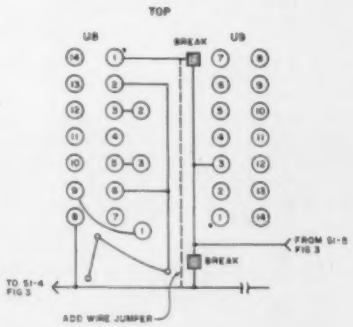


Fig. 4. 80A land pattern modification. Wiring (back) side of board.

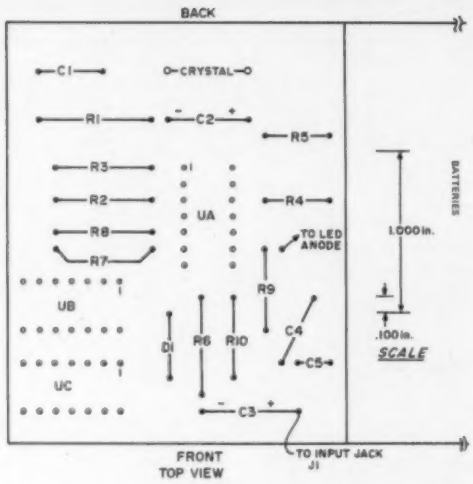


Fig. 5. Self-contained perfboard component locations.

$10, but the intermittent use of this unit pointed to the use of a battery supply for about $1. In order to obtain maximum use of the battery as its voltage decreases with age and use, a variable resistor, or as in my case, a switch with resistors (Fig. 2), was used to permit adjustment of the supply voltage. Too high a supply voltage causes a 2400 Hz output; too low a voltage results in no output. The correct voltage is easily obtained by first connecting earphones to the 1200 Hz output jack, J2, and then, starting at the maximum resistance, slowly reducing the resistance until the 1200 Hz signal is heard.

CONSTRUCTION

Self-Contained

The self-contained version layout is shown in Fig. 5 and the photograph. It is constructed on a 2.5" x 6" piece of .100 x .100 inch perfboard (Archer – Radio Shack – #276-1394). R11-R16 are mounted on the chassis, supported between S1 and S2.

80A

The 80A layout requires more effort, but it has the advantage of a more built-in feature. Fig. 6 shows the location of the components. The crystal socket, switch S1, and the module DIP socket were epoxied onto the component board. The terminal strip was anchored using the screw that attaches the component board to the camera chassis.

Operation

Adjust the 80A output control, R50, to 2/3 full scale (self-contained only). In order to measure only 1200 Hz, the SSTV voltage controlled oscillator (VCO) must first be forced into a 1200 Hz only mode. This can be done in the 80A by shorting the collector of Q8 to the emitter of Q8, by grounding the junction of resistors R34, R35 and R134. This method will result in a sync frequency of about 1190 Hz. The reason for the 10 Hz difference is that the normal "on" condition for Q8 is not a shorted collector to emitter, but rather a .1 volt collector to emitter. Since the more positive the collector of Q8 is from -15 volts, the lower the frequency, 0.0 volts = 1190 Hz, whereas 0.1 volts = 1200 Hz.

After the 1200 Hz only condition is satisfied, adjust R42, SYNC, so that the LED just barely flickers. This setting will result in about 1210 Hz when the short is removed. If a more accurate adjustment is desired, readjust R42 away from zero beat in a clockwise direction so that the LED flickers at about 10 beats/second, and then remove the short. This should result in an output very close to 1200 Hz.

Important Note (80A Version Only)

In the compare mode, the 1/4, FULL, 1/2 vertical scan switch must be in the FULL scan position in order to allow the divider chain to divide by 256.

Crystal Specifications

The crystal used in my model was ordered from International Crystal Mfg. Co. Inc., 10 North Lee, Oklahoma City OK 73102, according to the following specifications for 1200 Hz output: Frequency – 307,200 Hz, .01% tolerance; Type – GP; Calibration – room temperature; Holder – F605 (HC 6/U); Circuit Load – use Fig. 2.

The frequencies for other SSTV outputs are:

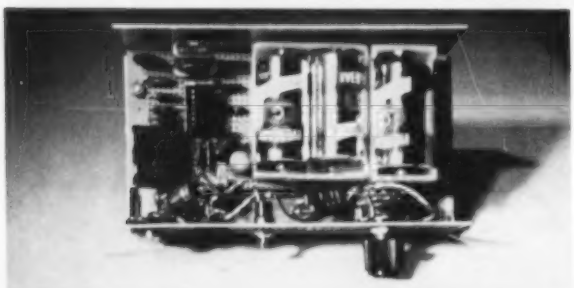
OUTPUT	CRYSTAL
1200 Hz	307,200 Hz
1500 Hz	384,000 Hz
2300 Hz	294,400 Hz
	(divide by 128)

Other Configurations

Other configurations that used the crystal controlled 1200 Hz output signal gated directly into the SSTV output during sync time were considered and analyzed. The 80A VCO mode was found to maintain more than sufficient stability at considerably less cost. These other designs are available by SASE.

Conclusion

The calibration capability described in this article provides the missing link towards ease in obtaining accurate alignment of not only the SSTV camera, but also the SSTV station monitor. An A-B comparison using the crystal controlled source calibration vs. a Yaesu model YC-355D has shown no significant difference in accuracy, but a substantial difference in cost. ■



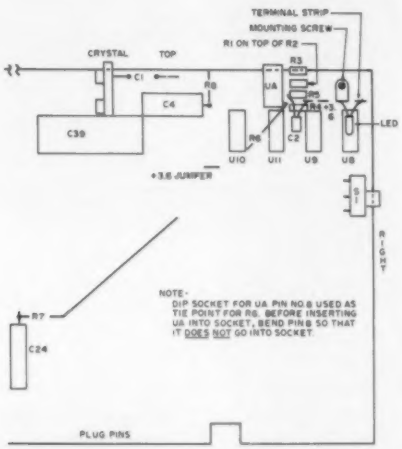


Fig. 6. 80A component positioning.

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What's All This Wire-Wrap Stuff?

--talk about cold solder joints!

The advent of digital electronics in amateur radio has paved the way for a new method of construction practice already widely used in industry. This is called the Wire-Wrap* method. One might ask, why Wire-Wrap? Just talking about the number of lines coming from an IC could make one's head reel. For example, let us assume that we have thirty 16 pin ICs, and that we have just one wire per pin as either a voltage, a ground, or a signal line. We now have 16 x 30, or 480 lines to interconnect. Can't you just picture the complexity of the printed circuit board required to accommodate such a circuit? Note that I'm talking about a 16 pin IC in this case. Now we are well into LSI and MSI with 24, 36, or 40 pin ICs becoming very popular. This is one reason why industry has gone the Wire-Wrap route. The mechanical design effort in laying out such a PC board is a time-consuming, costly operation. Most of the time a double-sided PC board with plated-through holes would have to be used. And in even more complex circuits, multi-layer boards would have to be designed.

A second advantage of Wire-Wrap over PC is the ease with which a design change can be accomplished. All one needs to do is unwrap the wire and put the new one in between the proper two terminals. We all know what it is like to modify a PC board. I have several scarred fingers from a slip of the knife as proof.

Now let's talk about some of the electrical and mechanical attributes of Wire-Wrap. A Wire-Wrap connection consists of approximately seven turns of 30 AWG solid copper wire. The wire is wound about a 0.025 inch square terminal in a helical manner, without the aid of solder. As the wire is wound about the terminal, the corners of the terminal bite into the wire, as the wire notches the sharp corner of the terminal. In this manner, a gastight, oxidationfree joint exists between the terminal and the wire. As the connection ages, a solid state diffusion process takes place, which enhances the mechanical strength of the connection. Through exhaustive tests it has been determined

* The term "Wire-Wrap" is a registered trademark of Gardner-Denver Co.

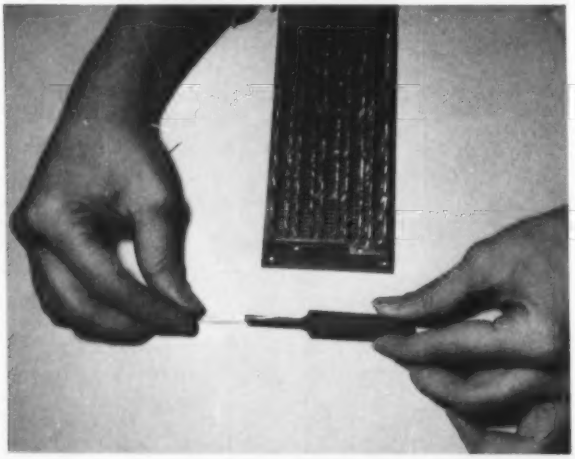

Fig. 1.

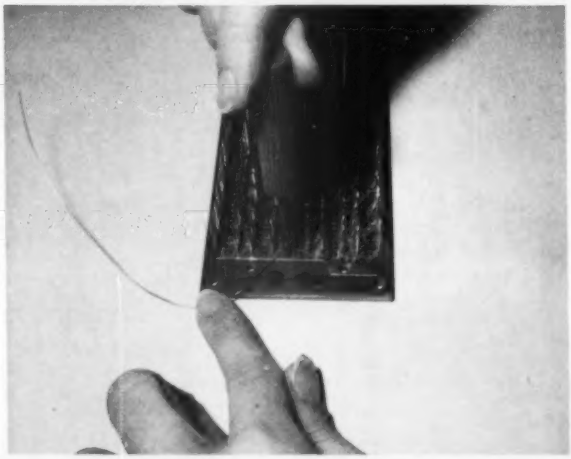

Fig. 2.

that a Wire-Wrapped connection has a life expectancy in excess of forty years. This tremendously exceeds the reliable life of a solder connection.

Wire-Wrapping can be accomplished through several methods. There are hand Wire-Wrap tools which are readily available and inexpensive. If many wraps are to be done, I would suggest the electrical hand gun; where a small run of similar boards are to be Wire-Wrapped, there is the semi-automatic method. A "head" with a Wire-Wrapping bit is indexed over the proper terminal through the use of a numerical controller. The fully automatic method would be chosen on a large run of similarly Wire-Wrapped boards.

Let's go through a step-by-step procedure to show the simplicity of the Wire-Wrap process:

Step 1. Insert the stripped end of the wire into the tool, as shown in Fig. 1.

Step 2. Place the tool with the wire over the terminal (Fig. 2).

Step 3. Twist the tool clockwise, until the stripped portion of the wire is used up in the wrap.

Fig. 3 shows a completed "modified" wrap. "Modified" means that there is approximately one turn of insulation around the terminal for strain relief.

Well, that about "wraps" it up. ■

Fig. 3.

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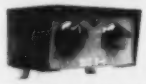
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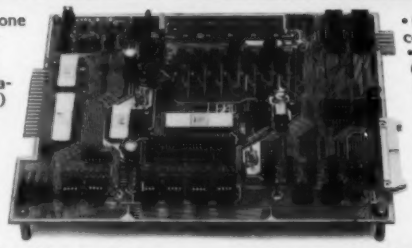

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All about kilobyte

WHY YOU WILL BE UNABLE TO PREVENT YOURSELF FROM SUBSCRIBING TO KILOBYTE

If you can profit from the experience of others and perhaps manage to save a few dollars which you might otherwise blow on something inferior, then you will be able to save much more than the cost of a Kilobyte subscription.

Kilobyte will be running articles on every piece of hardware available to the computer hobbyist ... and reader reports on their experiences with the hardware (and software). You can profit from the experiences of others. Kilobyte will pull no punches ... covering up for a lousy manufacturer serves no one in the long run and factual reporting on problems can help warn other hobbyists as well as encourage the manufacturer to get his act together. Look for a long and informative letters section where a spade will be called a spade.

If you are building a kit, for heaven's sake keep a notebook of your problems ... problems with the manufacturer ... with missing parts ... bad manuals ... bum parts ... and be sure to tell how you solved each of your problems as an aid to the next guy. Pass along data on how you got the system up and running, I/O problems and their solution ... where you got software ... etc.

CHARTER SUBSCRIPTION ONLY $12!

The regular subscription rate for Kilobyte will be $15 per year. The CHARTER rate is only $12. Individual copies will sell for a ridiculous $2.00 ... and be well worth it. In case you are thinking of waiting to see how Kilobyte looks, remember that thousands of waiters-to-see lost out on the first issues of Byte. Too bad ... the first issue of Byte now goes in some areas for more than the Charter subscription rate!

This is your chance to get a bargain ... please don't expect the first issue of Kilobyte to be in good supply.

HARDWARE REVIEWS IN KILOBYTE

In addition to the letters from readers explaining about the problems they have had with hardware (and software), plus articles by readers on hardware which they are enthusiastic about ... Kilobyte will be encouraging the manufacturers to write articles telling you the details of their equipment ... why they used such and such a chip ... what it does ... what this means to you as the possible user of the system ... why the bus was designed the way it was ... etc. Manufacturers are well aware that their articles will be read with skepticism and that their credibility is on the line ... so we expect them to be relatively candid, for in a marketplace such as this one, with many manufacturers competing very briskly for your business, credibility is of the utmost importance ... and a loss of credibility can well mean lost business.

Most of the new manufacturers of microcomputer hardware are starting small, usually with a minimum of financing ... so they need your business and confidence. You'll get to know these people through the pages of Kilobyte.

SOFTWARE PROGRAMS IN KILOBYTE

In addition to reviews of new hardware and reports from the readers on their problems, Kilobyte will be making every effort to encourage programmers to send in shorter programs for publication in Kilobyte ... short programs, routines, algorythms, written for use on hobby systems. It is hoped that this will eventually become a library which will be invaluable to you when you are writing programs. There have been a few programs published elsewhere, but these have been far too few.

Longer programs have a home too. Kilobyte will be producing longer programs on cassette tape for sale by mail and via computer stores ... complete with documentation. If you have some programs which you think might be of value ... and might sell well ... get in touch with Kilobyte. The page rate for articles in Kilobyte runs around $50 (about double that of other hobby computer magazines the last we heard), so short programs and routines could pay you very well if published. Longer programs will be on a royalty basis (15%) and the intention is to sell them at fairly low prices via stores so as to discourage copying and theft. Our experience with the 73 Morse Code tapes is that if cassettes are made available for reasonable prices there is little problem with copying.

KILOBYTE AIMED DIRECTLY AT NEWCOMERS TO COMPUTERS

Most of us are newcomers, one way or another. Only long time dedicated hobbyists are well grounded in hardware, software and systems ... the rest of us may know one or the other of these, but not all. The intention is to try and keep a good deal of the material in Kilobyte of a very fundamental nature so as to bootstrap newcomers into the hobby. This will even include a glossary page of computer terms to help the beginner.

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with an Altair . . . it has an 8800 with floppy disk, Imsai, Wavemate, Jolt, Apple, Southwest Tech, Sphere, Ebka, Intelligent Systems, Astral 2000 . . . various cassette systems such as the National Multiplex . . . printers by Southwest Tech, Teletype, Dec, MPI . . . terminals by Lear, Burroughs, Intelligent Systems . . . etc.

With this lab Kilobyte is able to check out the many systems available to the hobbyist . . . to interface I/O systems . . . to check memory and other new modules . . . and (most important) to check out programs submitted to Kilobyte for publication or for royalty distribution.

KILOBYTE TO SUPPORT COMPUTER STORES

Older hobbyists will recall that publisher Wayne Green predicted the proliferation of the computer store even before the first one was opened. Kilobyte will be available in every computer store that meets the Kilobyte requirements . . . as will the Kilobyte program cassettes.

In August 1975 the very first computer store was opened (in California) . . . by August 1976 there are over 50 recognized computer stores . . . and perhaps 150 one-man shops which hope to grow into stores soon. Considering the growth of the hobby computer it will not be surprising to many if there are about 500 stores by August 1977 . . . and 5000 by 1978.

Since only hobbyists have the wide background in all phases of computers to provide the services of a computer store, a great many of the readers of Kilobyte will find themselves faced with an economic opportunity of a lifetime . . . once they are qualified. This is all the more reason for getting your own computer system . . . and reading Kilobyte.

KILOBYTE TO COST ARM AND LEG AT STORES

Since Kilobyte is going to be a good deal better than the other hobby magazines it is only reasonable that it should be a little more expensive. $2.00 per copy at your stores.

WHO IS BEHIND KILOBYTE?

The staff of 73 Magazine will be putting Kilobyte together . . . it is a staff of over 40 people and every aspect of publishing is done right at the big 73 Magazine headquarters building in Peterborough except the actual printing of the magazine. Kilobyte requires very large web offset presses and equipment, so it will be printed in Columbus, Ohio . . . and mailed from there.

The editor, John Craig, has been running the I/O section of 73 Magazine since last February . . . a section of about 40 pages of hobby computer articles and advertising every month. Before that John was one of the editors of the famed Cabrillo newsletter. John works out of Lompoc, California.

At the Kilobyte/73 headquarters the type is set, articles proofread, pasted up, artwork prepared, advertising sold and prepared for publication, subscriptions and readers service handled by a professional group which has been working together for years. Add to this the new Prime computer system and you have a first rate organization. Visitors to New Hampshire are invited to join the thousands of amateur radio operators who visit the HQ and say hello.

WHO IS THE KILOBYTE PUBLISHER?

Wayne Green is not totally unknown in the hobby computer field. It was his frustrations with trying to get a computer system to use with 73 Magazine that resulted in his idea for Byte magazine in 1975. In a period of seven weeks Green managed to find an interim editor, get enough articles to get the magazine started, get mailing lists of prospective subscribers, write letters for subscriptions, get envelopes printed, send out the subscription letters and get in enough subscriptions to warrant printing 15,000 copies of the first issue . . . far too few, it turned out . . . but a lot more than the 2000 envisioned at first.

Green's visit to the microcomputer manufacturers in August 1975 was reported in detail in Byte and did a lot to help this small new industry grow. Green has followed this 1975 visit up with one in August 1976 and this will be reported in the first issue of Kilobyte.

Green started publication of 73 Magazine in 1960 and gradually built it from a one man operation to the present staff of over 40. 73 is the fastest growing ham magazine . . . over 30% increase during the first six months of 1976 . . . and soon will be the largest in circulation in the ham field. It is already more pages than any others and has more advertising.

Green, who is listed in the latest issue of Who's Who, in addition to being the editor and publisher of 73, starting Byte last year (no longer connected with Byte), also is the writer of a nationally syndicated newspaper column on CB radio.

MANUFACTURERS WHO CANNOT ADVERTISE

The 73 Magazine policy of not permitting firms to advertise where there are problems of stability, of service, a questionable product, etc., will be carried on in Kilobyte. Unless current problems with Minimicromart, Processor Technology, E&L instruments and Ebka are resolved you may not be seeing them in Kilobyte.

CAN YOU GET RICH VIA KILOBYTE

Of course you can! With Kilobyte paying about double what the other hobby computer magazines are (you *do* want to read the best authors, don't you?), you can parlay any field of expertise of your own into enough money to buy more hardware. Be sure that you know what you are talking about . . . and that you explain it simply, avoiding all the usual buzzwords. Write to Kilobyte, Peterborough NH 03458, or John Craig, RFD 100D, Lompoc CA 93436, for instructions on writing for Kilobyte . . . it's easy . . . and lucrative.

COMING ARTICLES

Articles have been promised for Kilobyte by some of the top people in the field . . . a rundown on just about everything available . . . a sort of super buyers' guide is being prepared by Eric Stewart of Computers and Stuff. This will probably run to three parts to cover everything. Eric started with his first store in Provo, Utah and then moved to the San Francisco area . . . he is moving to a larger building to try and keep up with the business.

George Morrow (Morrow's Micro Stuff) will be writing on cassette systems and interfacing . . . on a fantastically simple prototyping system he uses . . . Dennis Brown (Wavemate) will be writing about the benefits of wire wrapping and also give us the inside dope on how the Wavemate was designed . . . and why. We've also been promised good authoritative articles on the Jolt system, the new Godbout PACE computer, the Apple computer and the Z-80 CPU coming out by MITS. Marlin Shelly of MPI (printer) has promised an article on parallel I/O standards and connectors . . . George Tate of Computer Mart (Orange, Ca) will be writing on I/O configurations . . . Dick Wilcox, a teacher of computer systems in elementary schools will be writing about fundamental software terms . . . monitors, debuggers, editors, executives, and such.

WHAT ABOUT THE I/O SECTION IN 73?

This will continue, as it has, to bring fundamental computer info to radio amateurs through the pages of 73 . . . as well as computer applications for amateurs such as pointing beams for DX automatically, reading Morse Code, etc.

WHEN WILL KILOBYTE START?

The first issue will be out in December 1976 . . . dated January 1977. The deadline to be sure of getting this issue is November 1st . . . after that you may or may not, depending upon the demand. Remember what happened to Byte subscribers who waited.

Exploding the Power Myth

-- to set the record straight

Hubert Woods W9IK/XE1ZX
Calle Las Nubes 1760
Guadalajara 5
Jalisco, Mexico

It is widely believed, and often written, that reflected waves on an rf transmission line represent power flowing in the line toward the load and away from the load. Encouraged for many years by the teaching of a prestigious amateur organization, many amateurs take this belief as an article of faith.

But it is not only amateurs who so believe — some professionals do, also. They construct ingenious explanations of transmission line phenomena that are based on power flowing forward and backward on a transmission line terminated by a load not equal to the characteristic impedance of the line. They devise equations containing terms purporting to give the magnitude of power flowing toward the load and of power flowing in the reverse direction, and by subtracting one from the other get the "net power" flowing into the load. Never mind if the "forward power" is sometimes considerably larger than can be accounted for by the energy supplied by the transmitter in unit time — that is the way it must be, they say. Some of these professionals attempt to prove that "real power" flows both ways on the line, by referring to the readings of so-called directional wattmeters, and overlook the unproved and hidden assumptions that their explanation involves.

In this article I will attempt to show that power cannot correctly be said to flow in transmission lines in any direction. I will also point out inherent fallacies in some of the arguments presented to support the notion of power being associated with reflected waves. To accomplish these purposes, it will be essential to have a clear understanding of the basic definitions of energy and of power, and of the differences between them. In physics, *energy is the capability for doing work.* A bent spring possesses energy; a charge of gunpowder possesses energy; an electric current possesses energy because it can run a motor, or generate heat in a resistor, or be transformed into electromagnetic waves which then do work. In such cases, the work done (or heat generated, or electromagnetic waves produced) is also energy in other forms, in compliance with the laws of the conservation of energy.

Power is defined in the ARRL *Radio Amateur's Handbook* (50th edition, p. 22) as *the rate of doing work.* However, the ARRL now prefers (ref. 1) a somewhat different wording, taken from the *IEEE Standard Dictionary of Electrical and Electronic Terms* (1972 edition), as follows: *Power is the time rate of transferring or transforming energy.* To avoid any misunderstanding with the ARRL over the correct definition of power, I will use the one it prefers. A careful look at this definition shows clearly that the words "transferring" and "transforming" in that definition refer to energy, not to power. The definition would become absurd if it were taken to mean that "power is the time rate of transferring or transforming power." Therefore, the thing that is being transferred in an electric circuit or transmission line is energy, not power. The thing being transferred, energy, is what flows on the line, and any assumption that the definition supports the conclusion that power flows on the line is wholly unwarranted.

There is another cogent reason supporting the view that power does not flow in transmission lines. Power is a scalar quantity, that is, a quantity completely specified by a number (of basic units, such as the Watt) and having no direction in space, as contrasted with a vector quantity which requires not only a number but also a direction for its complete specification. Because power has no direction, it cannot correctly be said to flow in any direction (ref. 2). But what of the power quantity (E) (I) (cos Θ) as measured at the line input? Does this mean that power is flowing in the line? No, it does not. It means that the flow of electric energy in the line is such as to cause work to be done at the rate of (E) (I) (cos Θ) at some suitable place or places in the circuit, namely at one or more resistive loads (ideally, only in the equivalent radiation resistance of the antenna).

I know that it is commonplace to speak of power as flowing in rf and other electric circuits, and such informal speech often carries a useful, if inexact, meaning. But, in dealing with the rather complex phenomena on rf transmission lines, it becomes essential to use such terms as energy and power in accordance with their exact meanings.

Having discussed the basic definitions of energy and power and their significance, we can now examine some of the fallacies offered in support of the conclusion that reflected waves on a transmission line represent or contain power flowing in two directions.

1. An equation has been published (ref. 3) in the following form:

$$P = \frac{(E^+)^2}{Zc} - \frac{(E^-)^2}{Zc} = \text{"Net Power Flow"}$$

in which, to use the author's words, "the first term to the right of the P expresses the power associated with the incident wave, and the second term, the reflected power."

This equation treats power as if it were a vector quantity; it clearly implies, as do the author's words, that power flows both ways on the line simultaneously, and that power flowing one way can cancel, partially or wholly, the power flowing the other way. All of this is in direct conflict with the fundamental definition and meaning of power, as previously discussed.

2. It is sometimes claimed that the readings of "directional wattmeters" prove that power flows both ways on the line, thus representing power associated with the incident and reflected waves (ref. 4). These instruments are actuated by samples of the line current and line voltage (ref. 5). There is no uncertainty about the derivation of these meter readings. However, endowing these readings with meaning with respect to power in the incident and reflected waves requires two assumptions: first, that the incident and reflected waves have a physical existence on the line; and second, that they represent power flowing on the line. Neither of these assumptions is automatically shown to be correct by the meter readings themselves, which, as stated, are actuated by line current and line voltage, and which would continue to be the same readings obtained from the same line current and line voltage with the same phase angle *even if the incident and reflected waves had no physical existence on the line.* Thus the "directional wattmeter" readings do not prove that there is any power associated with these waves, or, in fact, that these waves have any physical existence.

3. When the line and load are considerably mismatched, the "directional wattmeter" indicates a much larger forward power (it is said) than can be accounted for by the energy output capability of the transmitter. This has been said to be "a normal condition which must exist in order for a mismatched load to absorb all the power delivered by the source, while at the same time reflecting a percentage of the total power it receives" (ref. 6). But as power is the time rate of transferring or transforming energy, how could the time rate of transferring or transforming energy *anywhere on the line* be greater than the energy put into it in unit time? This would be manufacturing energy out of nothing!

In summary, I have shown, I hope, by recourse to basic definitions and their meanings, that power does not flow in transmission lines or other electric circuits. I feel that there have been errors in some of the statements that have been published in support of the contrary view. It must therefore be concluded that reflected waves do not represent power flowing in a transmission line, in any direction. Let us hope that professionals (and amateurs, too) will take seriously the basic definitions of the terms they use so frequently. I confess that I have not always done so. ■

References

1. Personal letter from the ARRL, dated Jan. 29, 1974.
2. Personal letter from Dr. Chester H. Page, SI Units Coordinator, National Bureau of Standards, dated May 3, 1974. Dr. Page is also Chief, Electricity Division, Institute for Basic Standards, National Bureau of Standards. In view of the high position Dr. Page holds in the field of electrical definitions and their meanings, I quote, with his permission, the following sentence from his letter: "You are correct; power does not flow – energy flows."
3. Maxwell, M. Walter, "Another Look At Reflections," Part 3, *QST*, Aug., 1973, p. 43.
4. *Ibid.*, p. 42.
5. DeMaw, Doug, "In-Line RF Power Metering," *QST*, Dec., 1969, p. 11.
6. Maxwell, M. Walter, "Another Look at Reflections," Part 4, *QST*, Oct., 1973, p. 22.

I/O REPORT

from page 74

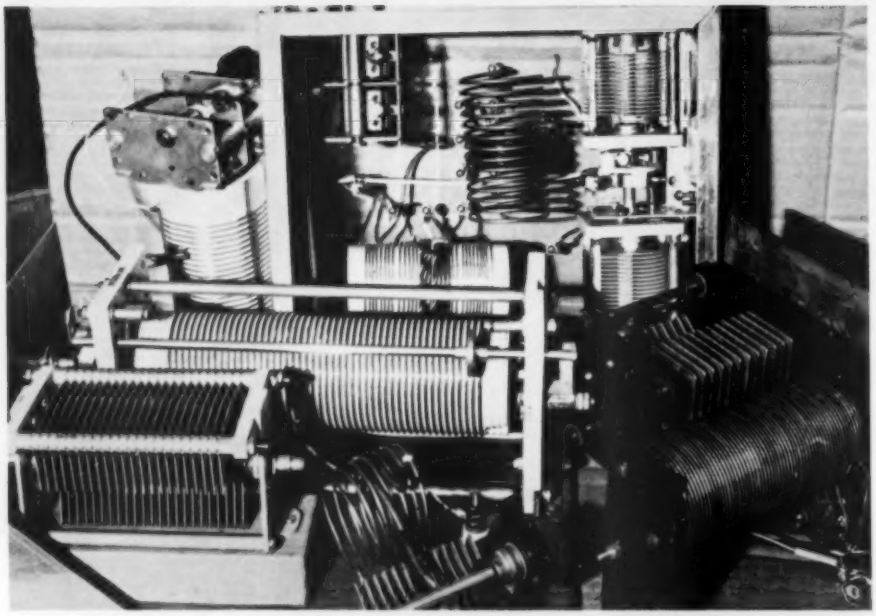
have any nifty software control of starting and stopping the tape.

The manual provided with the reader is excellent. It includes the theory of operation, construction (if you buy it in kit form), parts list, interfacing instructions, schematic, board layout, and most importantly, an 8080 program listing for bootstrapping programs in from the reader.

Interfacing the OP-80A is a breeze. The diagram of the I/O socket shown here illustrates the interface signals. These include the eight data lines, an acknowledge and a ready line (the S1 and S2 status inputs are optional and can be whatever you desire). The "data ready" (or Reader Data Available) is generated from the sprocket hole and the acknowledge signal must be generated by either hardware or software from the computer. (We interfaced the OP-80A to our Varian V-73 and its paper tape controller was kind enough to provide us with an acknowledge signal. For an 8080-based system, an output port would be used to provide this signal through software.)

One item which is missing from the "posed" photograph is a small high-intensity lamp (using a 12 volt auto lamp) which is placed directly over the read station. The light intensity "alignment" procedure is simply a matter of placing the light over the read station until the SP (sprocket) LED comes on.

The OP-80A is available from Oliver Audio Engineering, 7330 Laurel Canyon Blvd., North Hollywood CA 91605. The price is $74.50 in kit form or $95.00 assembled and tested (add $2.50 for shipping and handling). A lamp kit option is also available at $19.95 and a tape transport unit will be available in the future (for you lazy types).



The graveyard of abandoned matchits.

F. G. Rayer G3OGR
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Exploding the SWR Myth

-- to set the record straighter

As a regular user for years of end fed antennas, I have felt there should be some correct length, and some ideal or best way to tune the antenna and couple it to the transmitter. The latter item – the fabulous matchit – would peak up transmitted signal strength very well, rather like tuning a receiver pre-selector when receiving. (Admittedly a flatter response was expected, due to lower Q.)

Signal strength reports from contacts did not confirm this, nor did a remote pickup antenna, with diode and indicating meter. So tests were made to try to discover if the fabulous matchit existed, and to find it if it did.

As it had been amply demonstrated that an rf ammeter in the antenna lead gave maximum reading for maximum radiated signal, if operating frequency and the whole antenna-ground system remained unchanged, such a meter was used as the indicating instrument.

The Beginning

Putting the antenna directly on the Tx, Fig. 1(a) was the start. PA tuning and loading controls were far from their usual settings with the PA dipped, but PA grid and anode currents were noted, and also antenna current.

The roller-coil favorite matchit B was then introduced, set to its usual values. Complete readjustment of PA tuning was needed. Loading was set to get the same plate current as before. Hey ho, antenna current was exactly the same. Nor was any improvement possible, with changes to L and C, followed by PA re-tuning.

Never mind: Parallel tuning of this antenna length had often been used, so Fig. 2(a) was substituted. With customary adjustment of this parallel matchit, current shown by the rf meter was exactly as before. So both L and C were grossly changed from their "correct" values for the band, and tap T was moved to unusual positions. Provided it was still possible to load the PA to the noted input, antenna current was the same with all changes made.

Oh, Dear!

An excellent matchit well known for its ability to provide 1:1 swr on coax from the Tx was substituted, as shown in Fig. 2(b). With the swr at 1:1, antenna current stood at exactly the same figure as before. With the excellent matchit mistuned, 5:1 on the swr and PA dipped, antenna current was exactly the same.

Perhaps the antenna length was responsible? It was cut to length by the book, and was possibly humming with resonant energy?

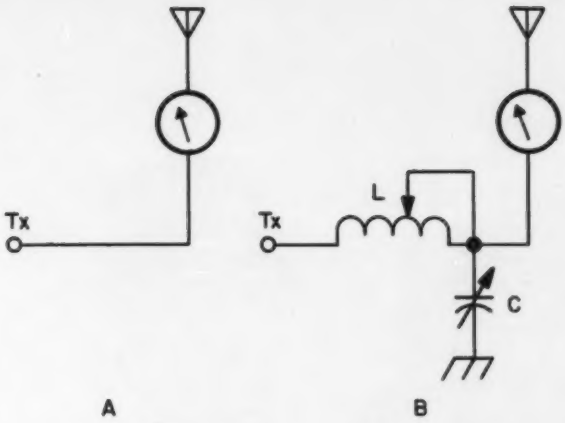

Fig. 1. Direct connection and roller coaster matcher.

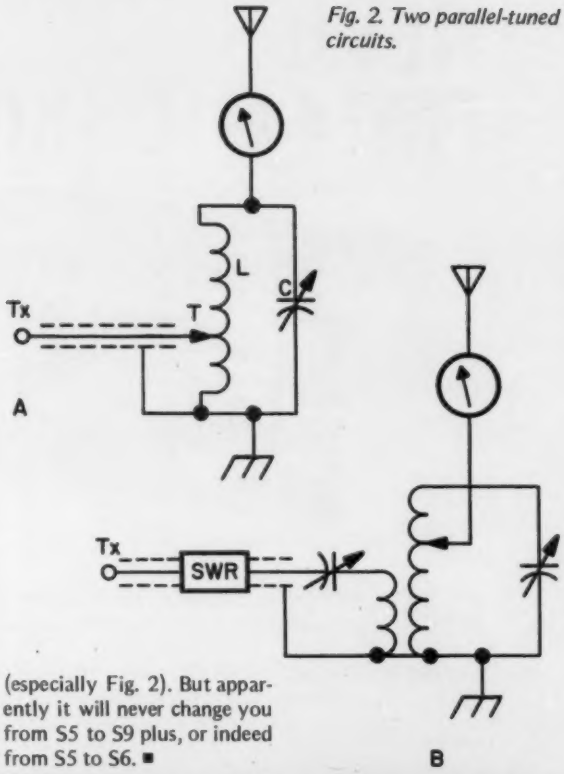

Fig. 2. Two parallel-tuned circuits.

No, changes to its length naturally altered the rf current, but starting again from Fig. 1(a), all remained the same.

Conclusion

Provided the PA can be loaded and dipped, any matchit, or indeed none at all, will give exactly the same signal strength. So what our favorite matchit does to justify its shelf space comes under other headings – it can bring an otherwise impossible antenna impedance within the range of the transmitter, it can let the Tx see a line with a low swr, if the Tx or a filter needs that, and it can be unfavorable to harmonics (especially Fig. 2). But apparently it will never change you from S5 to S9 plus, or indeed from S5 to S6. ■

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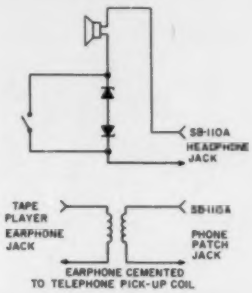

Fig. 1. Circuitry used to operate Heath SB-110A transceiver as a beacon station.

This revolutionary new concept in repeater design centers around an endless loop cassette cartridge. A thirty second CQ with calling instructions was recorded on a ninety second endless loop.

As the loop runs through a tape player, one hears the CQ followed by a minute of silence. When the player output is patched into a transceiver VOX circuit, the result is instant beacon. A word of caution on the patch: The dc component of the tape player output should be isolated from the VOX input to prevent nuisance tripping.

The only disadvantage I found with this simple arrangement is that it requires constant attendance at the transceiver. There are many times when I would prefer to listen for calls in my family room with the rest of the family. An extension speaker was easily added, but the wife would absolutely not condone the no-signal noise of the receiver. Obviously, a squelch circuit was in order. On the other hand, I had no desire to mutilate the transceiver or decrease its sensitivity.

An interesting problem indeed – how can the noise be squelched with minimum circuit disturbance? Low voltage zener diodes filled the bill. Two diodes, back to back in series with the speaker, will conduct only when their zener voltages are exceeded. Audio output level is adjusted so that the noise level is just below zener breakdown voltage. A SPST switch was added to short out the zeners for weak signal work.

I realize that this crude design could use some refinement, but I leave that to the perfectionists in our midst. ■

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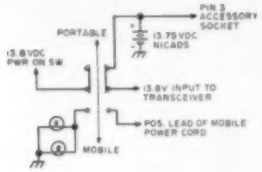


Fig. 1.

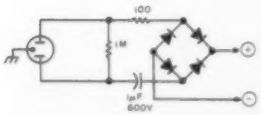


Fig. 2. Charger.

It all started with a desire to have a multi-channel, top quality performance, portable transceiver that I could carry with me on field trips, CD activities, repeater maintenance or just about anywhere.

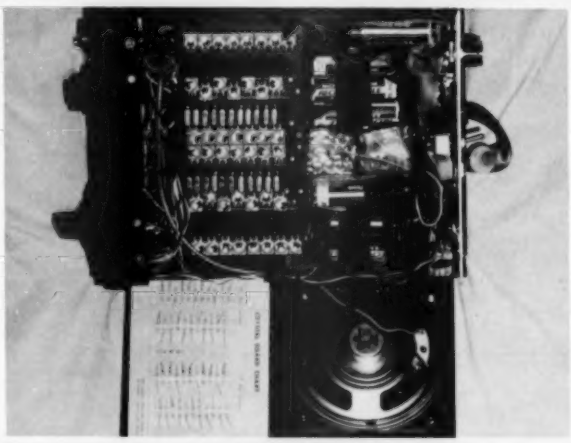
Looking at the problem from several different angles, I immediately saw that the cost of a new HT was just about out of the question. External battery packs are usually cumbersome and heavy – even messy. I popped the covers off my ICOM IC-22A and to my surprise there was plenty of room for an internal nicad battery pack. In fitting the batteries inside, I wanted to make the fewest possible outside modifications to the rig, so as not to detract from its clean-cut design.

The first step in this modification is to turn off the light bulbs. Next, insure that the normal external power source and the internal nicad pack are not paralleled together. I mounted a miniature DPDT toggle switch on the rear panel to accomplish this objective. I needed a battery charger input, so I connected the positive side of the nicads to pin 3 of the 9 pin accessory socket; pin 8 is negative ground.

Before installing the batteries, I decided it would be best to eliminate the possibility of the batteries rubbing against the bottom of the PCBA solder etchings, so I placed a piece of heavy gauge clear flexible plastic over the PCBA etch side.

Due to the voltage require-

Empty space available.



Batteries installed.

ment for optimum performance of the IC-22A, I hooked up eleven AA nicad cells in series, making a 13.75 V dc battery source. Current drain with the lights off is approximately 40 mA standby, 85 mA RCV, and 550 mA transmit in the 1 Watt position. If you choose to replace the speaker with a smaller one, you could fit in two plastic 6 pack battery holders. But if you do as I did, and leave the original speaker in, you need one 4 pack, one 3 pack and two double pack battery holders. It is not as neat looking, but it does fit without changing the original speaker.

For a nice finishing touch you might make up something sharp, like a black leather suede carrying case with a shoulder strap. Then hook up a rubber duckie with a right angle connector, and away you go. ■

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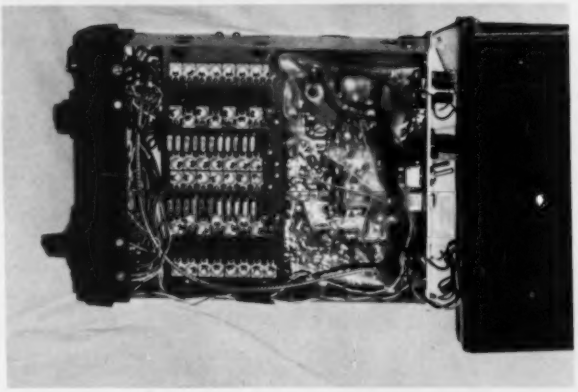

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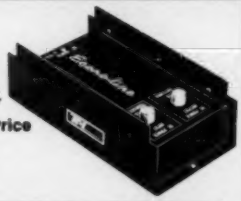

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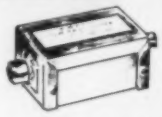

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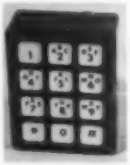

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FIG 1 PERSPECTIVE VIEW
FEED 50/75 50-OHM COAX TO SET 50 FEET SUPPLIED
FIG 2 TOP VIEW
6-TURN COAX BALUN COIL
FOR TUNING, ADJUST NUMBER OF EXPANDED TURNS
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FIG 3 FRONT VIEW
FIG 4 END VIEW

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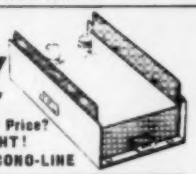

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Model	Input	Output	Typical	Frequency	Price
702	5-20W	50-90W	10 in/70 out	143-149 MHz	$139.00
702B	1-4W	60-80W	1 in/70 out	143-149 MHz	$169.00

Now get TPL COMMUNICATIONS quality and reliability at an economy price. The new Econo-Line gives you everything that you've come to expect from TPL at a real cost reduction. The latest mechanical and electronic construction techniques combine to make the Econo-Line your best amplifier value. Unique broad-band circuitry requires no tuning throughout the entire 2-Meter band and adjacent MARS channels. See these great new additions to the TPL COMMUNICATIONS product line at your favorite amateur radio dealer.

For prices and specifications please write for our Amateur Products Summary! FCC type accepted power amplifiers also available. Please call or write for a copy of TPL's Commercial Products Summary.

AMPHENOL

SERIES 581 — PACKAGED CABLE ASSEMBLES

All popular lengths are now available in your choice of RG 8/U or RG 58/U type low loss polyfoam dielectric cable. Installed PL-259 connectors are ASTROplated® — Amphenol's new non-tarnishing finish — which has all the advantages of precious metal plus more heat, corrosion and abrasion resistors that silver ever had!

RG 58/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES

581-5803: 3-ft. with ASTROplated PL-259's on both ends. ..... $ 3.82
581-5812: 12-ft. with ASTROplated PL-259's on both ends. ..... $ 5.08
581-5820-2: 20-ft. with ASTROplated PL-259's on both ends. ..... $ 5.88
581-5850: 50-ft. with ASTROplated PL-259's on both ends. ..... $ 8.94
581-5875: 75-ft. with ASTROplated PL-259's on both ends. $11.22
581-58100: 100-ft. with ASTROplated PL-259's on both ends. $12.98

RG 8/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES

581-803: 3-ft. with ASTROplated PL-259's on both ends. ..... $ 4.46
581-820: 20-ft. with ASTROplated PL-259's on both ends. $10.36
581-850: 50-ft. with ASTROplated PL-259's on both ends. $18.58
581-875: 75-ft. with ASTROplated PL-259's on both ends. $25.48
581-8100: 100-ft. with ASTROplated PL-259's on both ends. $31.96

ALL BAND PREAMPLIFIERS

- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp.

Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

MODEL PCLP is identical in all respects to the PLF except that two nuvistors are used instead of the FET.

Model PCLP 117V AC, 60 Hz. Wired & tested $39.00

UHF RF CONNECTORS

Low loss R-F connectors for Amateurs, Citizens Band and laboratory use. Silver plated for high RF conductivity.

A	PL-259	Coaxial Plug	$ .80
B	SO-239	Coaxial Receptacle	.68
C	M-359	Coaxial Right Angle Adapter	2.29
D	PL-258	Coaxial Junction	1.31
E	UG-175/U	Adapter for RG-58/U	.25
	DM	Double Male Plug	1.60

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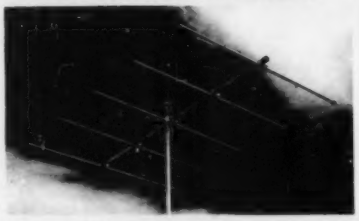
Prices FOB Medford MA. All units can be shipped UPS. Mass. residents add 5% sales tax. Orders over $1000 deduct 5%. Add $2 for shipping & handling on all orders.

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/9" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Mntch and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Logth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

new **RINGO RANGER for FM**

4.5 dB* — 6 dB**

Omnidirectional GAIN BASE STATION ANTENNAS

FOR MAXIMUM PERFORMANCE AND VALUE

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 2.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed taken PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz take 1½" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.37'	.20'	.10'

B-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 23' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK.	complete 4 element stacking kit
A14-SK.	4 element coax harness only
A147-VPK.	complete 11 element stacking kit
A147-SK.	11 element coax harness only
A449-SK.	6 + 11 element coax harness only

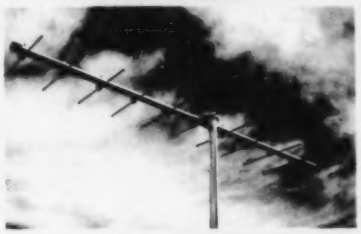
E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm Feed and PL-258 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/40"	44"/40"	60"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/26
½ Power beam	48°	66°	48°	66°	48°
Wind area sq. ft.	1.31	.43	.59	.30	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.6 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.6 dB, F/B ratio 22 dB, boom length 120", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS



3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O. D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O.D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Logth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	26 dB	26 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

VHF/UHF BEAMS			
A50-3	$ 27.50	A144-7	19.95
A50-5	39.50	A144-11	24.95
A50-6	59.50	A430-11	19.95
A50-10	89.50		

AMATEUR FM ANTENNAS			
A147-4	$ 15.95	AFM-44D	47.50
A147-11	24.95	AR-2	18.50
A147-20T	47.50	AR-6	24.50
A147-22	69.50	AR-25	21.50
A220-7	18.95	AR-220	18.50
A220-11	22.95	AR-450	18.50
A449-6	15.95	ARX-2	28.50
A449-11	21.95	ARX-2K	11.95
AFM-4D	53.50	ARX-220	28.50
AFM-24D	49.50	ARX-450	28.50

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- Rubber antenna

ONLY $399.00

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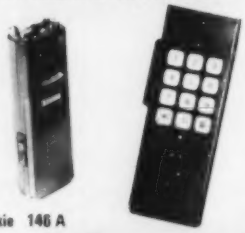


Walkie Talkie 146 A

Standard Communications

Magnetic Mount or Gutter Clamp — 5/8 wave – $38.50
Specify, 2 meters, 220, 450. — 1/4 wave – $18.50

Larsen Antennas

Larsen Antennas to fit Any Mobile Unit

3/8" single hole mount — 5/8 wave $31.50 — 1/4 wave 11.50

Touch Tone Enclosures – $2.95 each. Colors: Beige, Grey, Black.

HYE-QUE insulators by BUDWIG! Only 99¢ a pair . . . super high isolation for the end of your antenna . . . get the best for a good signal.

HYE-QUE Dipole insulator with coax connector built-in . . . handles KW . . . rain shield . . . increase antenna efficiency (bigger signal). Only $3.95.

BOMAR Crystal Company

Novice Crystals (Specify Band Only)

CRYSTALS IN STOCK

Standard ● Icom ● Heathkit ● Ken ● Clegg ● Regency ● Wilson ● VHF Eng ● Drake ● And Others!

NOW! Motorola HT 220 Crystals In Stock!

$4.50 @ Lifetime Guarantee

Make/Model	Xmit Freq.	Rec. Freq.

Please enclose $2.00 for shipping with your order.

ICOM IC-22S

Zero crystals. Solid state engineering enables you to program 23 channels of your choice without waiting. The frequency synthesizer can be preset to any 15 kHz channel between 146 and 148 MHz by the diode matrix board. This frequency may be offset by 600 kHz higher or lower than the receiver frequency. IC-22s – $289.00

THE FIRST AND STILL THE LEADER!

the IC230 $489.00

Put Over 67 Channels in the Palms of Your Hands

SPECIAL FEATURES:

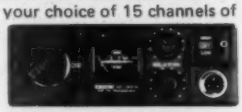
- No more Crystals — Over 67 fully synthesized channels available.
- All Channel Capability — Travel with confidence that you'll be able to work all repeaters along the way.
- Super Compact — 2.38" high x 6.14" wide x 9.72" deep at a weight of only 5.5 lbs.
- Quick Dismount Mobile Mount — Allows quick car installation.
- Easy Operation — Punch up frequency, select repeater or simplex mode, and you're on the air. (A crystal may be added for a unique repeater frequency.)
- Modular Construction — In case of a problem, modules can easily be removed and sent for repair. A replacement module will be air mailed to minimize down time.
- Super Hot Receiver — Better than 4uv/20db sensitivity, helical filters to eliminate intermod . . . plus a super E filter and a mosfet front end.

If There Is A Signal, You'll Hear It On The IC-230!

$50 Merchandise Credit with each IC-230

HOW TO SAVE $75.00 WHEN YOU BUY YOUR IC-22A FROM TUFTS

With each IC-22A at $249.00, get your choice of 15 channels of crystals at only $2.50 per crystal.



IC-22A
146 MHz FM 10 W Transceiver

- 22 channel capacity
- 10 W nominal power output w/one Watt low power position
- Frequency range 146-148 MHz
- Intermediate Frequencies 10.7 MHz First I.F., 455 kHz second I.F.
- .4 microvolts sensitivity for 20 dB quieting, .3 microvolts for 12 dB SINAD
- Audio power – 1 Watt into 8 Ohms

IC-21A 146 MHz FM 10W transceiver – $399. DV-21 Digital VFO – $299.

IC-21A

* Low intermod, due to MOS-FET RF Amp and 5 helical resonator filter, plus 3 I.F. filters.
* IDC modulation control provides for minimum bandwidth and channel splatter.
* Virtually no intermod. Due to MOS FET RF amp and 5 helical cavities in the front and plus FET mixer and 3 I.F. filters.
* Variable output power. 10 watts output or another output between 500 milliwatts and ten watts may be selected by an external control.
* S.W.R. bridge, built right into the front panel of the IC-21A, is an accurate meter for VHF S.W.R. bridge. An invaluable aid in VHF antenna experiments!
* The IC-21A contains both the 117 VAC and the 13.6 VDC power supplies.

DV-21

* The perfect companion for your IC-21 or IC-21A, the DV-21 is a unique digital synthesizer to complete your ICOM 2 meter station. The DV-21 will operate in 10 kHz steps over the entire 2 meter band. It can also scan frequencies being used. Completely separate selection of the transmit and receive is as simple as touching the keys. Release the mic switch, and the receive frequency is displayed. There are also two programmable memories for your favorite simplex frequencies. You won't believe the features and versatility of the DV-21 until you've tried it.
* Advanced feature of the DV-21 – the ability to capture 5 kHz split tertiary with a 10 kHz synthesizer. The 0-5 kHz offset provides the mean to get exactly on the frequency; but even in the scan mode, the channel may be scanned and understood.
* The DV-21 has its own built-in 117 AC power supply as well as the ability to operate from the 12 VDC line.

Touchtone® Handset (TTH-230) – $99.95

600 OHM Microphone – $18.00

Mobile Mount (IC-MM) – $13.95

Base Microphone – $39.50

DC Power Cord (IC-DCC) – $5.00
Power Connector Only (IC-PC) – $5.00

Revers & Reading Dial for 22A – $2.00

ICOM
ICOM EAST, INC.

IC-3 PA Regulated Power Supply with Speaker – $89.95

9 Pin Accessory Plugs (9PP) – $2.00

Burglar Alarm – $34.95

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

Matching speaker unit (3854) and complete external VFO (3855) also available.

See the incomparable Hy-Gain 3750 at your radio dealer or write Department MM. There is no substitute.

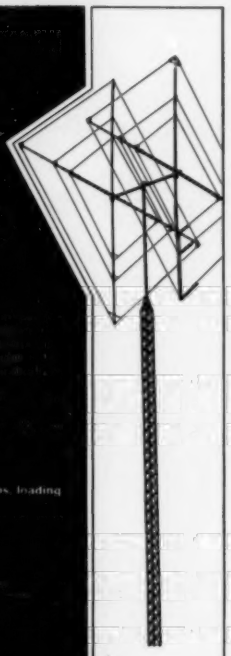
3854 – $59.95 3750 – $1895.00 3855 – $495.00

There is no substitute.

hy-gain Amateur Radio Systems.

Hy-Quad 10-15-20 Meter Antenna 3-bands, 2 elements, 1 package

Complete from Hy-Gain.



- Individually tuned gamma matches on each band.
- Exclusive gotex feed.
- Full wave element loops require no tuning stubs, traps, loading coils or baluns.
- Horizontally polarized.
- VSWR less than 1.5:1 at resonance on all bands.
- Mounts on any mast 1 1/4 to 2 1/2 diameter.
- 52 ohms impedance.
- Accepts maximum legal power with ease.
- Boom length 8'.
- Spreaders 25 ½' overall.
- Turning radius 13 ft.
- Weighs just 42 lbs. complete.

Order No. 244

hy-gain Amateur Radio Systems.

$219.95

Hy-Gain's Incomparable HY-TOWER for 80 thru 10 Meters

Model 18HT
- Outstanding Omni-Directional Performance
- Automatic Band Switching
- Installs on 4 sq. ft. of real estate
- Completely Self-Supporting

By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical ¼ wavelength (or odd multiple of a ¼ wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power...delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. Top mast, which extends to a height of 50 ft., is 6061ST6 tapered aluminum. All hardware is iridite treated to MIL specs. If you're looking for the epitome in vertical antenna systems, you'll want Hy-Tower. Shpg. Wt., 96.7 lbs.
Order No. 182 Price: $259.95
NEW . . .
Special hinged base assembly on Model 18HT allows complete assembly of antenna at ground level . . . permits easy raising and lowering of the antenna.

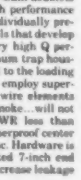
MULTI-BAND HY-Q TRAP DOUBLETS

Hy-Q Traps

- Install Horizontally or as Inverted V
- Super-Strength Aluminum Clad Wire
- Weatherproof Center and End Insulators

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke...will not stretch...withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cycolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

BROAD BAND DOUBLET BALUN for 10 thru 80 Meters Model BN-86



The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95
Shpg. Wt. 1 lb. Order No. 242

Hy-Gain REEL TAPE PORTABLE DIPOLE for 10 thru 80 Meters Model 18TD

The most portable high performance dipole ever...

The Model 18TD is unquestionably the most foolproof high performance portable doublet antenna system ever developed. It has proven invaluable in providing reliable communications in vital military and commercial applications throughout the world. Two stainless steel tapes, calibrated in meters, extend from either side of the main housing up to a total distance of 132 feet for 3.5 mc operation. 25 ft. lengths of polypropylene rope attached to each tape permits installation to poles, trees, buildings...whatever is available for forming a doublet antenna system. Integrated in the high impact housing is a frequency to length conversion chart calibrated to meter measurements on the tapes...makes installation foolproof. Feeds with 52 ohm coax. Delivers outstanding performance as a portable or permanent installation. Measures 10x5½x2 inches retracted. Wt., 4.1 lbs. $94.95
Order No. 228

CENTER INSULATOR for Multi-Band Doublets Model CI

Strong, lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ¾" coaxial cable. Shpg. Wt., 0.6 lbs. $5.95
Order No. 155

PORTABLE ANTENNAS

Rugged, durable, continuously loaded antennas designed for portable applications. Constructed to withstand rough handling. Completely insulated with vinyl coating. Can be bent at all angles without destroying or cracking protective finish. Cannot be accidentally shorted out.

Frequency	136-470 MHz (specify model)
VSWR	2.0 to 1 or less
Loading Coil	Plated wire, silver solder, cad. plated brass base

Model 274 – $9.00 Model 275 – $7.00 Model 269 – $7.00

MODEL 280Q for 40 and 80 meters. 100" 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs. $49.95
Order No. 380

MODEL 580Q for 10, 15, 20, 40 and 80 meters. 94" overall. Takes maximum legal power. Shpg. Wt., 12.2 lbs. $79.95
Order No. 383

Hy-Gain SINGLE BAND DOUBLET Model HD-4

High performance single band doublet installs horizontally or as inverted V. Takes 500 watts P.E.P. Supplied with cutting instructions for 10, 15, 20, 40 or 80 meter operation. Complete with miniature center and end insulators, 50' RG58/U and necessary copper clad stranded steel wire. Shpg. Wt. 3.3 lbs.
Order No. 214

END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95 Order No. 156

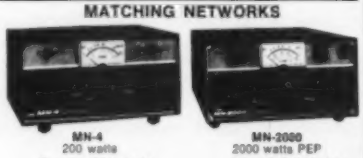
- *Remote*
- *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

- Control unit works on 110/220 VAC, 50/60 Hz. and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. **Price: $120.00**

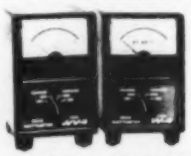
MATCHING NETWORKS



MN-4
200 watts
Price: $110.00

MN-2000
2000 watts PEP
Price: $220.00

General: • **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power • **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 • Covers ham bands 80 thru 10 meters • **Switches in or out** with front panel switch • **Size:** 5½"H, 10⅜"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14⅛"D (36.5 cm).
• **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) • **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.



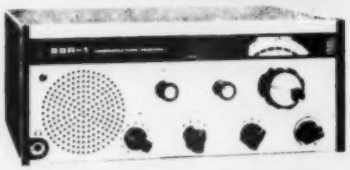
RF WATTMETERS

W-4 1.8-54 MHz Price: $ 72.00
WV-4 20-200 MHz Price: $ 84.00

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3⅝"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	±(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE



- **Synthesized • General Coverage**
- **Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands**
- **Excellent Performance**

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.
The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.
Price: $350.00

SSR-1 COMMUNICATIONS RECEIVER

GENERAL: • **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges • **Solid State VFO** with 1 kHz dial divisions • **Modes** SSB Upper and Lower, CW and AM • **Built-in Sidetone** and automatic T/R switching on CW • **30 tubes and semi-conductors** • **Dimensions:** 5½"H, 10¾"W, 14⅜" D (14.0 x 27.3 x 36.5 cm), **Wt.:** 16 lbs. (7.3 kg).

TRANSMIT: • **VOX or PTT** on SSB or AM • **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts • **Adjustable pi-network.**

RECEIVE: • **Sensitivity** better than ½ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception. **Price: $599.00**

34-PNB Plug-in Noise Blanker	100.00
FF-1 Crystal Control Unit	46.95
MMK-3 Mobile Mount	7.00
RV-4C Remote VFO	120.00

TR-4C SIDEBAND TRANSCEIVER

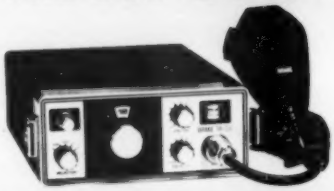
POWER SUPPLIES

AC-4 Power Supply	$120.00
DC-4 Power Supply	135.00

2 Meter FM Portable Transceiver

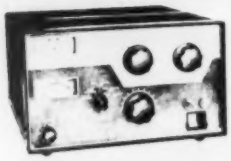
DRAKE

MODEL **TR-33C**



Amateur Net $229.95

- SCPC* Frequency Control
- 12 Channels with Selectable Xmtr Offsets.
- All FET Front-end and Crystal Filter for Superb Receiver Intermod Rejection.
- Expanded Antenna Choice.
- Low Receiver Battery Drain.
- Traditional R. L. Drake Service Backup.
- Single Crystal Per Channel



LINEAR AMPLIFIER L-4B

L-4B Linear Amplifier 895.00

• **2000 Watts PEP-SSB** • **Class B Grounded-Grid** — two 3-500Z Tubes • **Broad Band Tuned-Input** • **RF Negative Feedback** • **Transmitting AGC** • **Directional Wattmeter** • **Two Tautband Suspension Meters** • **L-4B** 13-15/16"W, 7-7/8"H, 14-5/16"D. **Wt.:** 32 lbs. • **Power Supply** 6-3/4"W, 7-7/8"H, 11"D. **Wt.:** 43 lbs.

POWER SUPPLIES

AC-4 Power Supply	$120.00
DC-4 Power Supply	135.00

TVI MAY BE ELIMINATED WITH THESE DRAKE FILTERS

TV-5200-LP (formerly TV-1000-LP) rated 1000 watts input, 200 watts on 6 meters. SO-239 connectors built-in. $19.95.

TV-42-LP is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for citizens band and other transmitters 30 MHz and lower. Rated 100 watts input. SO-239 connectors built-in. $10.95

TV-3300-LP 1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. $19.95

TV-300-HP High Pass Filter provides more than 40 dB attenuation at 52 MHz and lower. Protects the TV set from amateur transmitters 6 thru 160 meters. $9.95

TUFTS

Radio Electronics

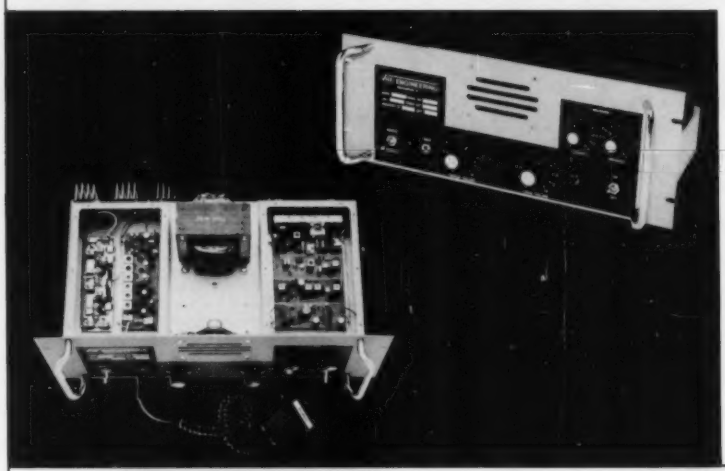
386 Main St., Medford MA 02155
Phone: 617-395-8280

NEW ENGLAND'S FRIENDLIEST HAM STORE

BANKAMERICARD

master charge

IF YOU ARE ON 144, 220 OR 432 AND HAVE WORKED A REPEATER...



It was probably this one.

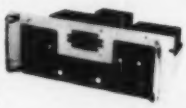
The RPT 144B, RPT 220B and RPT 432 are self-contained — all solid state machines. Conservatively rated, high quality components, assures EXCELLENT RELIABILITY. Careful consideration has been given to both interfacing and control flexibility.

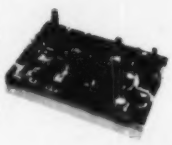
RPT 144B or RPT 220B Kit $465.96
RPT 432B Kit 515.95
RPT 144B or RPT 220B factory wired and tested 695.95
RPT 432B factory wired and tested ... 795.95

Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS & EQUIPMENT

TX144B Kit . .	transmitter exciter — 1 watt — 2 meters	$ 29.95
TX144B W/T. .	same as above — factory wired and tested	49.95
TX220B Kit . .	transmitter exciter — 1 watt — 220 MHz	29.95
TX220B W/T. .	same as above — factory wired and tested	49.95
TX432B Kit . .	transmitter exciter 432 MHz . . .	39.95
TX432B W/T. .	same as above — factory wired and tested	59.95
RX50C Kit . .	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit. .	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T. .	same as above — factory wired and tested	114.95
RX220C	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX432C Kit. .	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF.	accessory filter for above receiver kits gives 70DB adjacent channel rejection	8.50
HT144B Kit . .	2 meter — 2w — 4 channel — hand held xcvr with crystals for 146.52 simplex	129.95
PA2501H Kit .	2 meter power amp — kit 1w in — 25w out with solid state switching, case, connectors	59.95
PA2501H W/T.	same as above — factory wired and tested	74.95
PA4010H Kit .	2 meter power amp — 10w in — 40w out — relay switching	59.95
PA4010H W/T.	same as above — factory wired and tested	74.95
PA144/15 Kit .	2 meter power amp — 1w in — 15w out — less case, connectors and switching	39.95
PA144/25 Kit .	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit .	similar to PA144/15 for 220 MHz	39.95





PA432/10 Kit .	power amp — similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10 . . .	10w in — 140w out — 2 meter amp — factory wired and tested .	179.95
PA140/30 . . .	30w in — 140w out — 2 meter amp — factory wired and tested .	159.95
RPT144 Kit . .	repeater — 2 meter — 15w — complete (less crystals)	465.95
RPT220 Kit . .	repeater — 220 MHz — 15w — complete (less crystals)	465.95
RPT432 Kit . .	repeater — 10 watt — 432 MHz (less crystals)	515.95
RPT144	repeater — 15 watt — 2 meter — factory wired and tested	695.95
RPT220	repeater — 15 watt — 220 MHz — factory wired and tested	695.95
RPT432	repeater — 10 watt — 432 MHz — factory wired and tested	749.95
PS3 Kit.	12 volt — power supply regulator card	8.95
PS15C Kit . . .	NEW — 15 amp — 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T . .	same as above — factory wired and tested	94.95
PS25C Kit . . .	NEW — 25 amp — 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T . .	same as above — factory wired and tested	149.95

OTHER PRODUCTS BY VHF ENGINEERING

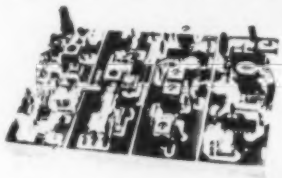
CD1 Kit	10 channel receive xtal deck w/diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
COR2 Kit . . .	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX	19.95
Crystals	we stock most repeater & simplex pairs from 146.0-147.0 (each)	5.00
Synn II Kit . . .	synthesizer kit for 2M FM	169.95
CWID Kit	automatic identifier for repeaters, RTTY, etc.	39.95
CWID wired . .	same as above — wired	49.95

Build a 2 meter or 220 MHz Transceiver.

10 Channel Scanning . . . 15 Watt

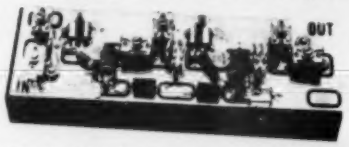
You can put it all together for only $219.95

RX144C or RX220C Receiver Kit



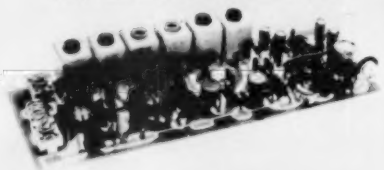
SENSITIVITY .3uV for 20db quieting. SQUELCH THRESHOLD .2uV. AUDIO OUTPUT 2 watts. STABILITY better than —.002. IMAGE REJECTION 60db. SPURIOUS REJECTION greater than 60db. IF REJECTION 80db. FIRST IF 10.7 Mhz. SECOND IF 455 Khz. BANDWIDTH 15 Khz at 3db, 60 Khz at 30db (40 Khz with optional 4 pole filter). CRYSTAL 45 Mhz parallel at 20pf (HC/25U holder).

PA144/15 - 15 Watt Power Amplifier

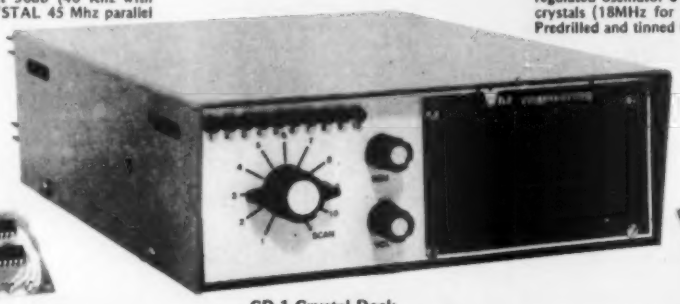


POWER GAIN; 12 db nominal, INPUT POWER; 2 watts max., INPUT VOLTAGE; 12 to 14 volts DC negative ground, INPUT CURRENT; 4 amps max., STANDBY CURRENT; virtually insignificant, INSERTION LOSS; less than 1 db on receive, DUTY CYCLE; 50% or less. Consists of drilled glass PC Board, heat sink and all components.

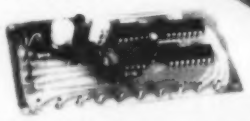
TX 144B or TX220B Transmitter Kit



A one watt exciter using four RF transistors, two diodes, and one integrated circuit. The RF transistors are operating well below their ratings allowing long keying periods without damage. • Nominal output 1½ watts • Deviation adjusted to 10KHz • IC audio with clipping and active filter • All spurious outputs down 30db or more • Temperature compensation crystal trimmer • Zener regulated oscillator • Uses readily available 12 or 18 MHz crystals (18MHz for 220) • All tuning coils prewound • Predrilled and tinned G-10 Circuit board



SC-3 Scanner

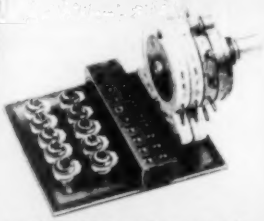


Capable of scanning up to 10 channels. Scan delay allows both sides of a conversation to be monitored without the scan starting each time the carrier drops. The priority feature allows the user to program the scanner to return to his favorite channel whenever it is active.

CD-1 Crystal Deck

A ten channel receiver crystal deck which utilizes diode switching to select the crystal position required.

CD-2 Crystal Deck



Designed to provide multi-channel operation for the TX-series transmitters. It features an extra set of contacts that may be wired to the CD-1 crystal deck for 10 channel transceive. The extra contacts may also be used to switch L.E.D. indicators. The switch has 11 positions.

Complete with cabinet, speaker, hardware, L.E.D.'s, all accessories and full assembly instructions.

(Crystals and microphone not included.)

WORK ALL REPEATERS WITH

OUR NEW

SYNTHESIZER II

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 KHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 KHz to 10 MHz. No additional components are necessary!

Kit . . . . . .$169.95 Wired and tested $239.95

ARGONAUT, MODEL 509 AMPLIFIER, MODEL 405

TEN-TEC

TRITON IV

Model 206

TRITON IV A new push-pull final amplifier with the latest gold metalized, zener protected transistors, operating at 200 input watts on all hf bands 3.5 through 29.7 MHz. Plus a new crystal heterodyne VFO for improved short and long term frequency stability and uniform 1 kHz readout resolution, even on ten meters. Unsurpassed selectivity is yours with the new eight pole i.f. crystal filter, and improved spurious rejection results from the new IC double balanced mixer.

Many small circuit improvements throughout, taken collectively, add more performance and quality pluses – such things as individual temperature compensated integrated circuit voltage regulators for final bias control and VFO supply. And toroid inductances in the ten and fifteen meter low pass filters, LED indicators for offset tuning and ALC threshold, accessory socket for added flexibility, and sequentially keyed mute, AGC and transmitter circuits for even better shaped and clickless CW.

TRITON IV $899.00
12 ac supply, with a built-in speaker and VOX #262G $129.00

ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters, 9 MHz crystal filter, 2.5 kHz bandwidth, 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 ..... $329.00
Linear Amplifier, Model 405 ..... 159.00
Power Supply, Model 251 (Will power both units) 79.00
Power Supply, Model 210 (Will power Argonaut only) 27.50

MODEL 206 CRYSTAL CALIBRATOR SPECIFICATIONS

Power Required: 9 to 12 VDC @ 8 mA.
Fundamental Frequency: 100 kHz
Circuit Description: Pierce crystal oscillator, followed by Schmitt trigger. Output gated from unijunction oscillator.
Calibration: Adjustable to WWV with internal variable capacitor.
Size: HWD 2-1/8" x 4-3/8" x 4-1/8"
Weight: ½ lb.
Model 206 Crystal Calibrator $26.95

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. **PRICE $67.50**

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. **PRICE $38.50**

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. **PRICE $25.00**

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. **PRICE $15.00**

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weighting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortlessly. The iambic (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing.

PRICE $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms
Power Source: 117VAC, 50-60 Hz, 6-14 VDC
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2¼" x 5¼" x 8¼"
Weight: 1¾ lbs.

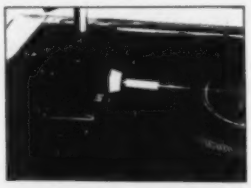
TEN-TEC

KR50A

Flip — You Use It

Fits new or existing antennas up to 48" long.
No unsightly holes.
Mounts on trunk rain channel, left rear position advisable.
Instructions and mounting hardware included.

Flop — You Hide It



Helps prevent theft of CB Radios and antennas. Antennas are the first thing thieves look for.
Allows automatic car washing without dismantling the antenna.
Same or lower S.W.R. than conventional trunk mount installations.

SHUR-LOK
SHUR-LOK MFG. CO., INC.

1976 Shur-Lok Mfg. Co., Inc.
Parent Pending

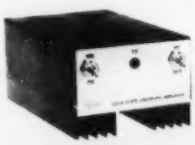
SHUR-LOK

Disappearing Antenna Mount $11.95

Mount will accept trunk or roof mount antennas. Antenna and coax not included

- Fully VSWR & reverse voltage protected
- No tuning required across band
- Switchable Class C or AB operation
- Built-in TR switching, w/increased delay for SSB
- Fully compatible with all 1-15W FM/SSB/AM/CW rigs
- All solid-state and microstrip construction

Mobile Amplifiers With Versatility



SCI **SPECIALTY COMMUNICATIONS SYSTEMS, INC.**

FREQUENCY MHz	MODEL	INPUT POWER NOM.W	OUTPUT POWER NOM.W	OPERATING CURRENT @13.6VDC	SIZE CM HXWXL	RETAIL PRICE
220-225	1.3M10-60L	10	60	7	7.1X10.2X16.5	159.95
144-148	2M10-70L	10	70	8	7.1X10.2X16.5	139.95

NEW 160 thru 10 meters CONTINUOUS DUTY AMPLIFIER

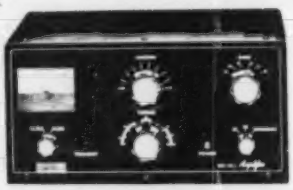
the SUPERAMP™ from DenTron

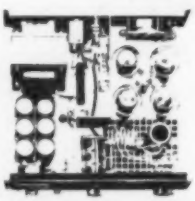
How would you like to be roaring into any shack on the globe? Now you can do it with the advanced 160-10L Amplifier from DenTron. The most critical features you are looking for have been skillfully engineered into this American-made amplifier.

The 160-10L has FOUR 811-A tubes with full cooling, continuous duty ratile, that make it capable of running 2000 watts P.E.P. input in your SSB mode. In addition, you'll get the built-in value of THREE more: 1. AC power. 2. Antenna Change Over. 3. Bias and cooling speed. But these features are only the beginning. The real nucleus of the 160-10L is its heavy duty, power supply. Pride yourself in operating an amp that can loaf along at 1 KW input on SSTV, RTTY, or CW and 2000 PEP SSB. The ruggedness of the 160-10L lets you enjoy the full benefit of operating far beyond normal working conditions.

Even the controls have been designed for ease of operation. They're up front and plenty big so you can get to them in a hurry and make your tuning adjustments that much faster.

So if you want to work the world and work it right, the 160-10L is for you. It's a SUPERAMP! Order yours today from DenTron Radio or your nearest dealer. $499.50





160-10L SPECIFICATIONS

Size: 7¼"H. x 14-7/8" x 14"D.
Weight: 43 lbs.
Frequency Range:
1.8MHz (1.8-2.1) 3.5 MHz (3.4-4.4)
7 MHz (6.9-8.0) 14 MHz (13.0-16.0)
21 MHz (16.0-22.0) 28 MHz (28.0-32.0)
Power Input:
SSB 2000 P.E.P.
CW 1000 watt DC Continuous
SSTV 1000 watt DC input 25 minute continuous
RTTY 1000 watt DC input 25 minute continuous
TUNE 1000 watt DC input 15 minute continuous
Output Impedance:
50-75 ohms Pi network wide range
VSWR not to exceed 2 to 1
Third-order Distortion: Down at least 30 db.

Meter Selector Switch, Plate Voltage, Plate Current
Built-in Antenna change-over relay
Dual-speed Cooling System
AC input Source 110V or 220V AC, 50-60 Hz
Automatic Circuit Breaker Protection

160-10L FEATURES

- 160 thru 10 meters
- 2000 watts P.E.P. on SSB
- 1000 watts DC on CW, RTTY or SSTV
- "On Demand" Variable forced air cooling system
- Self contained continuous duty power supply
- 4- 811A Triodes in Grounded Grid mounted in cooling chamber
- Compact, low-profile, solid, one-piece cabinet, take cooling chamber eliminates need for perforated cabinet
- Covers HAM Frequencies without modifications
- Broadbanded input and output circuit
- 70 watt drive for maximum legal limit

DENTRON

160-10AT SUPERTUNER™

Want an antenna tuner to match everything between 160 and 10 through balanced line, coax line and random line, pump out the full legal limit and look and sound good doing it? Supertuner™ is the one for you at just **$129.50**

160-10AT-3K SUPER SUPERTUNER™

Designed and engineered to be compatible with the full power highly efficient modern amplifiers now available to the amateur. In our opinion the finest tuner on the market today. **$229.50**

80-10AT SKYMATCHER™

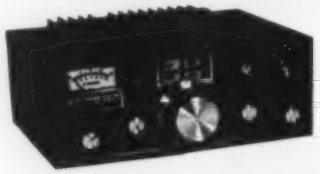
Here's an antenna tuner for 80 through 10 meters, handles full legal power and matches your 52 ohm transceiver to a random wire antenna. 80 10AT is yours for only **$59.50**

W-2 WATTMETER™ $99.50

Dual in-line wattmeter 2 individual meters reads reflected and forward watts at same time.

- 7"W. x 3½"H. x 6"D.
- Sensor Box – 4"W. x 2½"H. x 2½"D.
- Has 2 SO – 239 Connectors.
- Forward watt scale – 2000 or 200.
- Reflected watt scale – 200 watts.
- Low insertion loss.
- Sensor Box may be extended 4 feet.
- Meter accuracy ±5%.
- Weight 5 lbs.

For all you hams with little cars ...



We've got the perfect mobile rig for you.

The Atlas 210x or 215x measures only 9½" wide x 9½" deep x only 3½" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

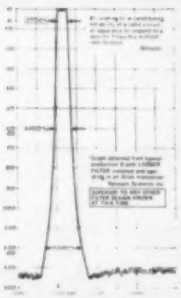
180 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 8 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-180 meters. Adding the Atlas Model 10t Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

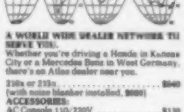
MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accurate for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.



PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9300 Hertz at 120 db down! Ultimate rejection is in excess of 130 db, greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.



A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

210x or 215x $849
(with noise blanker installed, $889)

ACCESSORIES:
AC Console 110/220V $139
Portable AC supply 110/220V ..... $ 95
Plug-in Mobile Kit ..... $ 44
10x Osc. less crystals ..... $ 99
Digital Dial DD-60 ..... $109

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

- ☐ **ARRL HANDBOOK** The standard comprehensive manual of amateur radiocommunication. 53rd Ed. **$6.00** U.S. Possessions, **$7.00** Canada, **$8.00** Elsewhere
- ☐ **UNDERSTANDING AMATEUR RADIO** Written for the beginner—theory and how to build it. 2nd Ed. **$4.00** U.S. & Possessions, **$4.50** Elsewhere
- ☐ **VHF MANUAL** A new and thorough treatment of the amateur v.h.f. field. 3rd Ed. **$4.00** U.S. & Possessions, **$4.50** Elsewhere
- ☐ **LICENSE MANUAL** Complete text of amateur regs, plus Q&A for amateur exams. 7th Ed. **$1.50**
- ☐ **HOW TO BECOME A RADIO AMATEUR** All about amateur radio and how to get started. 29th Ed. **$1.50**
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- ☐ **LEARNING THE RADIO TELEGRAPH CODE** Based on the accepted method of sound conception. Covers the basics on up to high speed "copy" **$1.00**
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- ☐ **SINGLE SIDEBAND FOR THE RADIO AMATEUR** The best s.s.b. articles from QST. 5th Ed. **$3.00** U.S. & Possessions, **$3.50** Elsewhere
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- ☐ **OPERATING MANUAL** The techniques of operating your amateur station—filing, rag-chewing, traffic, emergencies, etc. 3rd Ed. **$3.00** U.S. & Possessions, **$3.50** Elsewhere
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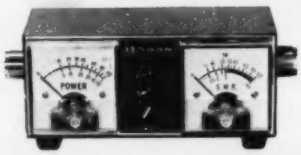
- ☐ **ARRL ELECTRONICS DATA BOOK** 128 pages of useful tables, charts and diagrams. 1st Ed. **$4.00** U.S. and Possessions, **$4.50** Elsewhere

why waste watts?



SWR-1 guards against power loss for $21.95

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

DELUXE 742 TRI-BAND MOBILE ANTENNA

- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna $79.95

EXCLUSIVE DELUXE 5-BAND MOBILE 45 ANTENNA

- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna $114.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

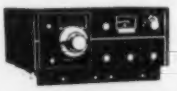
WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $49.95

WM3000 Peak-reading Wattmeter. Reads RMS power, then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $66.95

WM1500 High-Accuracy In-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales, 2 to 30 MHz. Forward and reflected power. Use it for trouble shooting, too! $64.95

SWAN® ELECTRONICS

Hams the world over value amateur radio products from Swan Electronics. Among the most respected of these are the unique single-sideband rigs with that "special something" extra -- like those illustrated here.



55-300A

SWAN 55-300A Transceiver. Fully solid-state, unique broadband tuning on all five bands, and infinite VSWR protection. Maintains up to 300 watts P.E.P. input on any frequency selected. $799.95

700 CX

SWAN 700CX Champion Transceiver. 700 watts P.E.P. input on the five most popular amateur bands. No other manufacturer gives you this much power and convenience for your money. $649.95

SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. $849.95

MARK II

CYGNET 1200X PORTABLE LINEAR AMPLIFIER

To quadruple the output of the 300B Cygnet de novo, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. $349.95

1200 X

Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details or, if you prefer, write:

SWAN® ELECTRONICS

NORTH SHORE
RF TECHNOLOGY

DUPLEXER & CAVITY KITS...

Now available for you fully assembled and tuned!

- UPGRADE YOUR REPEATER WITH A RF TECHNOLOGY DUPLEXER.
- ALL DUPLEXERS AND CAVITIES ARE TEMPERATURE COMPENSATED WITH INVAR® AND MEET ALL COMMERCIAL STANDARDS
- ONLY TOP QUALITY MATERIALS GO INTO OUR PRODUCTS.
- BOTH KITS & ASSEMBLED DUPLEXERS AND CAVITIES ARE AVAILABLE TO YOU AT A SAVINGS TO YOU.

Mod. 62-3...6 cav., 2 mtr., insertion loss 0.6 db with isolation 100 db typical; pwr. 350 w. Kit $349 ea.-Assembled $439.

Mod. 4220-3...4 cav. 220 MHz insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kit $249 ea. - Assembled $329.

Mod. 4440-3...4 cav. 440 MHz, insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kits $249 ea. - Assembled $329.

Mod. 30 Cavity Kits: 2 mtr. $65 ea., 220 MHz $65 ea., 440 MHz $65 ea.,; 6 mtr. $115 ea. Add $15 for Assembled Kit.

Also available: 6 mtr., 4 cav. Kit $399-Assembled $499, 2 mtr. 4 cav. Kit $249-Assembled $329, 440 MHz TV Repeater Duplexer

Only hand tools are necessary to assemble Kits!

Send your order to: Distributor: **TUFTS RADIO**, 386 Main St., Medford, Mass. 02155. Phone (617) 395-8280.

(Prices F.O.B. Medford, Mass. All units can be shipped U.P.S.-C.O.D. orders require $50 deposit. —Mass. residents add 5% sales tax.)

THE BIG SIGNAL $12.95

"W2AU" BALUN

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.

THE PROVEN BALUN

1. HANDLES FULL 2 KW PEP AND THEN SOME. Broad-Banded 3 to 40 Mc.
2. HELPS TVI PROBLEMS By Reducing Coax Line Radiation
3. USES ALL STAINLESS STEEL HARDWARE, 302/39 Double Silver Plated
4. IMPROVES F/B RATIO By Reducing Coax Line Pick-Up
5. REPLACES CENTER INSULATOR. Withstands Antenna Pull of Over 600 Lbs.
6. BUILT-IN LIGHTNING ARRESTOR. Helps Protect Balun — Could Also Save Your Valuable Gear
7. BUILT-IN HANG-UP HOOK. Ideal For Inverted Vees, Multi-Band Antennas, Dipoles, Beam and Quads

NOW BEING USED BY ALL BRANCHES OF THE U.S. ARMED FORCES, FAA, DCA, CIA, CANADIAN DEFENCE DEPT. PLUS THOUSANDS OF HAMS THE WORLD OVER.

THEY'RE BUILT TO LAST...

BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models, 1:1 matches 50 or 75 ohm unbalanced coax line to 50 or 75 ohm balanced load. 4:1 model matches 50 or 75 ohm unbalanced coax line to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT

The big super W2AU Balun reflects the type of quality that has kept our product out front and number 1 in Baluns the world over for the past 10 years.

The originator of the Balun with a built-in lightning arrester and hang up hook.

IT'S WHAT'S INSIDE THAT COUNTS!

We'll GUARANTEE no other balun, at any price, has all these features.

Now...more than ever--- the TEMPO line means solid value

Tempo VHF/ONE

the "ONE" you've been waiting for

No need to wait any longer — this is it! Whether you are already on 2-meter and want someting better or you're just thinking of getting into it, the VHF/ONE is the way to go.

- Full 2-meter band coverage (144 to 148 MHz for transmit and receive.
- Full phase lock synthesized (PLL) so no channel crystals are required.
- Compact and lightweight — 9.5" long x 7" wide x 2.25" high. Weight — About 4.5 lbs.
- Provisions for an accessory SSB adaptor.
- 5-digit LED receive frequency display.
- 5 KHz frequency selection for FM operation.
- Automatic repeater split — selectable up or down for normal or reverse operation.
- Microphone, power cord and mounting bracket included.
- Two built-in programmable channels.
- All solid state.
- 10 watts output.
- Super selectivity with a crystal filter at the first IF and E type ceramic filter at the second IF.
- 600 Selectable receive frequencies.
- Accessory 9-pin socket.

• $495.00

TEMPO SSB/ONE SSB adapter for the Tempo VHF/One • Selectable upper or lower sideband. • Plugs directly into the VHF/One with no modification. • Noise blanker built-in. • RIT and VXO for full frequency coverage. • $225.00.

ASTATIC MICROPHONES

SILVER EAGLE

T-UG8-D104, transistorized	$48.60
T-UG9-D104, "Golden Eagle," transistorized	$95.40
T-UG9-D104, "Silver Eagle," transistorized	$54.60
UG-D104, ceramic or crystal	$42.60

— TUFTS LIBRARY —

Foreign Radio Amateur Callbook	$12.95
U.S. Radio Amateur Callbook	$13.95
A.R.R.L. Radio Amateur Handbook	$ 6.00
A.R.R.L. Radio Amateur License Manual	$ 1.50
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Amateur Radio Advanced Class License Study Guide	$ 5.95
Amateur Radio Extra Class License Study Guide	$ 5.95

73 PUBLICATIONS

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Weather Satellite Handbook	$2.95
Code Tapes — 5, 6, 14 & 21 wpm	$3.95/ 4 for $13.95
Test Equipment, Vol. I	$2.95
Hobby Computers Are Here!	$4.95

mounts - leads - accessories

STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL BBLT-144

47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. **$20.75**

MODEL BBL-144

47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. **$26.95**

SUPER GAIN MOBILES

Two Meters — CGT-144

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS— TRUNK LIP MOUNT — CG-144

MODEL HFT

Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259. **$21.45**

HUSTLER "BUCK-BUSTER"

MODEL BF-2

51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included). **$12.70**

HEAVY DUTY BUMPER MOUNT FITS ANY SHAPE BUMPER

MODEL BMH

New design is rugged for supporting Hustler antenna with standard ⅜"-24 base resonators. Includes Model SBM-2 ball mount and strap. Fits stainless steel. **$11.95**

HFT

DELUXE MOBILE MOUNTS

For medium length, light weight antennas with ⅜"—24 base.

MODEL TLM

Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached. **$12.80**

MODEL HLM

Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. **$14.85**

MODEL GCM-1

Rain gutter mount fits all shapes, angles even latest from line gutters. Includes 180° swivel ball. **$7.50**

MODEL SBM-1

Cowl mount installs in 1" hole. Includes 180° swivel ball and PO-259 connectors. **$ 8.45**

MODEL TGM-1

Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. **$7.50**

MODEL C-32

Ball mount complete with mounting hardware. **$5.75**

VHF/UHF ANTENNA— ROOF MOUNT

MODEL UHT-1

Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅝" hole. Includes 15' RG-58-U **$10.15**

UHT-1 TH7

RESONATOR SPRING— STAINLESS STEEL

MODEL RSS-2

Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation. **$ 3.95**

RSS-2

MODEL GS-144 — ⅝ wave, two-meter antenna. Includes radials for complete decoupling. SWR at resonance: 1.5:1 or better. Height: 48". Power rating: 200 Watts FM **$21.95**

GS-144

MODEL CGT-144

Get big signal performance, superior receiving capability with this 85" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259. **$29.95**

MODEL CG-144

Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. **$26.75**

VHF/UHF ANTENNA— TRUNK LIP MOUNT

MODEL THF

Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. **$15.85**

SBM-2 SB-1

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE

MODEL SBM-2

Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cylindrical base, steel back-up plate and mounting hardware. **$13.95**

QUICK DISCONNECT— 100% STAINLESS STEEL

MODEL QD-1

Remove antenna from mount with easy press and twist release. Connection strong and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other. **$11.75**

QD-1

FEED LINE — MODEL L-14-240

Get known performance, maximum shielding for minimum noise pickup in this MIL SPEC 30 length of RG-58 U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver. **$ 7.45**

L-14-240

MODEL GS-144A — Deluxe, Two Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ¼ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator ⅝ wave lower section, ⅝ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind Survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. 50-239 coax connector **$82.95**

GS-144A

HUSTLER RESONATORS

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS— Power Rating: 400 watts SSB

Model	Band	Price
RM-10	10 meters	$10.75
RM-15	15 meters	$11.75
RM-20	20 meters	$12.75
RM-40	40 meters	$13.95
RM-75	75 meters	$16.95
RM-80	80 meters	$16.95

SUPER HUSTLER RESONATORS— Power Rating: Legal Limit SSB. Supers have widest band-width

Model	Band	Price
RM-10-S	10 meters	$13.95
RM-15-S	15 meters	$14.95
RM-20-S	20 meters	$15.25
RM-40-S	40 meters	$23.50
RM-75-S	75 meters	$29.95
RM-80-S	80 meters	$29.95

RM-S RM 4-STV

Covers 10 - 15 - 20 - 40 Meters

Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-STV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.8 to 1 or better at band edges.
- Hustler exclusive trap covers "Spritz" extruded to otherwise unobtainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss—high strength insulators. Mounting hardware included.
- All sections ⅜" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5" Weight: 15 lbs.
MODEL 4-STV $79.95

For 6 - 10 - 15 - 20 - 40 - 75 - 80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

MD-1 MD-2

HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

MODEL MB-2

For bumper mounting—Fold is at roof line 27" above base. **$15.95**

MODEL MB-1

For deck or fender mounting—Fold is at roof line 15" above base. **$15.95**

HUSTLER

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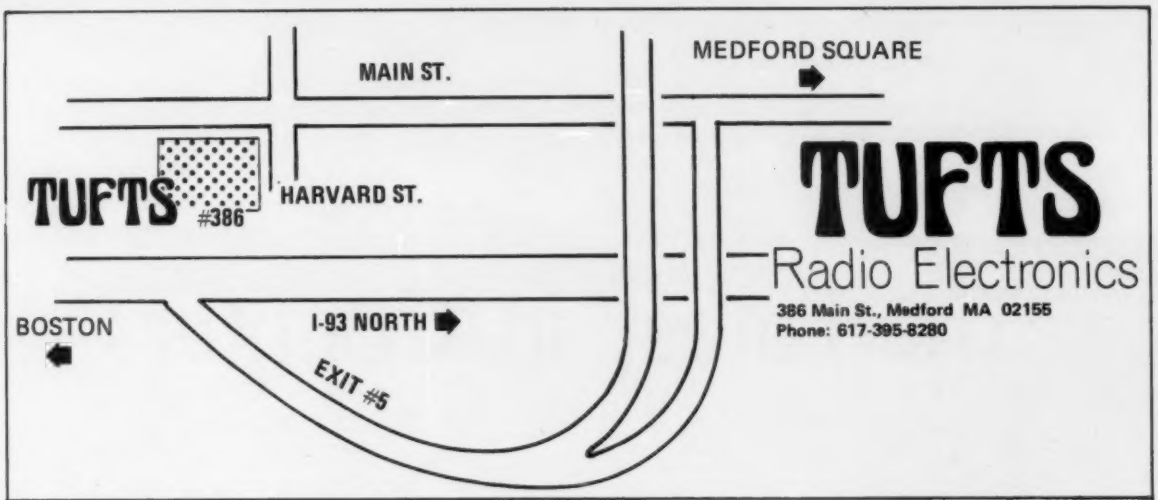
Radio Electronics



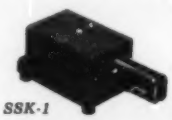
TUFTS
Radio Electronics

386 Main St., Medford MA 02155
Phone: 617-395-8280

NyeViking

All styles of Speed-X™ Telegraph Keys are constructed on heavy die cast bases with brass or nickel plated hardware, smooth adjustable bearings and heavy duty coin silver contacts.

310-001 – Black wrinkle base, no switch, $6.65
310-003 – Black wrinkle base with switch, $8.20

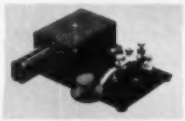


SSK-1

Model SSK-1 Features: extra-long form-fitting molded paddles with adjustable spring tension . . . adjustable contact spacing. Knife-edge bearings. Extra-large, gold-plated silver contacts. Nickel-plated brass hardware. Heavy die cast base with non-skid feet. Base and dust cover black-crackle finished. $23.95

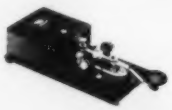
Shipping weight, 2¼ pounds

SSK-3



Model SSK-3. Same as SSK-1, but mounted on a solid metal sub-base which is drilled and tapped to mount your choice of any standard NYE VIKING SPEED-X™ key, (to be ordered separately.) $26.95

Shipping weight, 2¼ pounds



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160-10M	XCVR W/O Processor	659
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SP-101B	Speaker	19
SP-101PB	Speaker/Patch	59
YO-100	Monitor Scope	199
YD-844	Dynamic Base Mike	29
FA-9	Cooling Fan	19
MMB-1	Mobile Mount	19
RFP-102	RF Speech Processor	89
XF-30C	600 Hz CW Filter	45
XF-32A	8 Pole SSB Filter for FT-101	49
FR-101S		
SOLID STATE, 160-2M/SW RCVR		499
FR-101 Digital		
SOLID STATE, 160-2M/SW RCVR		659
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FC-2	2M Converter	40
FM-1	FM Detector	20
–	Aux/SW Crystals	5
XF-30B	AM-Wide Filter	45
XF-30C	600 Hz CW Filter	45
XF-30D	FM Filter	49
SP-101B	Speaker	19
FL-101		
SOLID STATE 160-10M TRANSMITTER		554
Accessories:		
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YC-355D	200 MHz Counter	289
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FT-2 Auto 8CH/2M 200R	FM Scanner Sigmasizer 200CH, 2M FM Synthesizer	379 449
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FT-221	2M AM/FM/CW/SSB	679
Accessories:		
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MMB-3	Mobile Bracket (200R)	19
MMB-4	Mobile Mount (FT-620B, FT-221)	19

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Model 114-404-002 consists of one standard transmitting key (Model 114-310-001), linear circuit oscillator and amplifier with built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included) $18.50

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Units may be connected in parallel so that two or more operators can practice sending and receiving to each other. Model 114-404-001 consists of amplifier and speaker assembly only, for use with any NYE VIKING key.

Shipping weight ½ pound

322-001

Model 320-001 – Black wrinkle base $8.65
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Model 322-001 – Black wrinkle base with brass hardware $8.65
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The Latest in Counters

-- an inexpensive modularized 50 MHz system

Geoffry W. Kufchak WA1UFE
869 Reed Ave.
Akron OH 44306

I finally decided I needed a relatively simple but effective counter. It had to be easy to build and it had to be able to count to 50 MHz without using a prescaler. After giving the design approach considerable thought, I decided on the plug-in board method. Then I proceeded to break up the total circuit into the individual circuits that make up a frequency counter and design PC boards for each of them. Counter circuits are pretty basic and there are only so many ways to design one, so this one may look a lot like others. I did, however, add a few ideas of my own.

One of the worst features of any counter is the awful current drain that the LEDs in the display manage to consume. Even with current-limiting resistors, 8 digits at 20 mils per segment can pull 1.12 Amps. I got around this by scanning the display so that only one LED is on at a time. This reduces current consumption by one eighth. I also decided to get rid of that ridiculous number of resistors, since scanning the LEDs gave me a 10% duty cycle. This meant that the average current through the LEDs would be 10% of the maximum current without resistors. Checking the specs for the LEDs I was using (MAN8) showed that at 5 volts the maximum current per segment would be 192 mils (OUCH!). But 10% of that is 19.2 mils and is within the maximum of 40 for the LED. The maximum current drain is now reduced to 134.4 mils when the display is showing an 8.

Another change I made is the use of a 74LS90 as the first counter in the chain. The 74LS90 is pin replaceable for the 7490 and will count in excess of 50 MHz. Some designs use the 74196, which uses inverted logic as compared to the 7490. The 74LS90 uses the same logic so board design is simplified.

I also added the option of

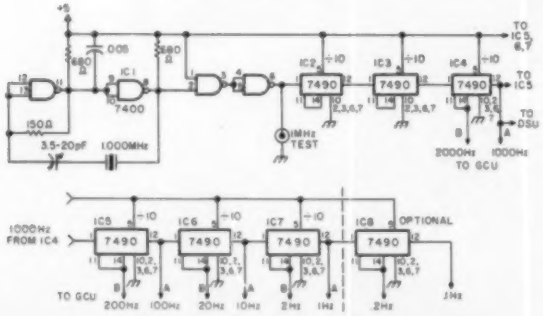

Fig. 1. Timebase Oscillator and Divider.

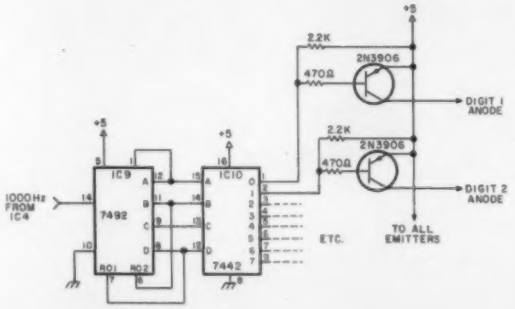

Fig. 2. Display Scan Unit.

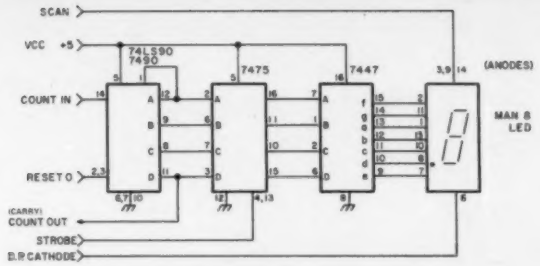

Fig. 3. Decimal Counter Unit.

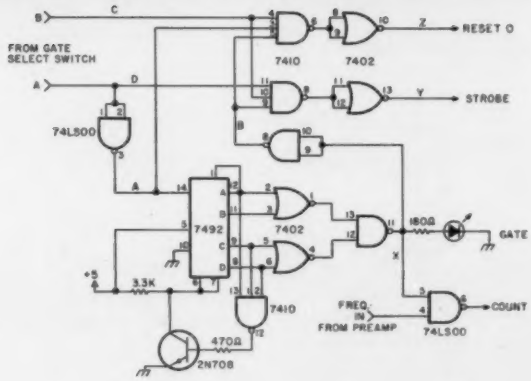

Fig. 4. Gate Control Unit.

selectable gates, .01 sec, .1 sec, 1 sec, and 10 sec.

Breaking the counter down into individual boards, there is the Time Base Oscillator and Divider (TBOD), Display Scan Unit (DSU), Decimal Counter Unit (DCU), Gate Control Unit (GCU), and Preamp. All these units plug into a master board which has all the interconnecting circuit paths etched into it.

Approximate cost, less cabinet, is about $85.00 using all new parts, less if you have a well-stocked junk box and can make the boards yourself.

Timebase Oscillator and Divider

The TBOD is constructed on a PC board that is 3.5" by 2". Due to the compactness of the circuit it was necessary to use jumpers for the frequency outputs. A double-sided board could be made and eliminate that need, but in the effort for simplicity I decided against it. The TBOD consists of a 7400 NAND gate for the oscillator and a series of 7490s wired to divide by 10 in the bi-quinary mode. This method gives a symmetrical square wave at the output, needed for proper gate timing. Also, the divide by 5 signal is brought to the edge of the board, as these frequencies are also needed. 1000 Hz is also used by the Display Scan Unit, so it has two outputs.

I was curious as to the stability of this circuit, since the crystal I'm using only has a tolerance of .005%, so I checked it against a 1 MHz signal with a known accuracy of 1×10^{-9}. I was quite surprised to find that it was as good as 1×10^{-8} after a one hour warmup, and held its accuracy hours later.

Provision has also been made for bringing the 1 MHz signal out to the back panel of the counter for checking it against another signal.

This is also the most expensive of the units, costing about $15.00 with all new parts.

Display Scan Unit

The DSU is also built on a 3.5" by 2" PC board. The DSU has a 7492 divide by twelve counter wired to reset to 0 at the count of ten. The BCD outputs of the 7492 are connected to the BCD inputs of a 7442 decimal decoder, which is used to scan the display LEDs by switching the Vcc on and off through a PNP switching transistor. The emitters of the transistors are connected to positive 5 volts and the collectors are routed to the anodes of the LED display. Pull-up resistors are used to keep the transistors biased off, along with current limiting resistors on the bases. If 5 volts does not provide enough brilliance from the LEDs, a slight modification on the board will enable you to use a higher voltage for switching to the display. Try not to use more than 10 volts, however. More than that and the LEDs may burn out.

The outputs of the 7442 are active low. That is, the output selected is at ground and all others are high. Grounding the base of a PNP transistor turns it on and switches Vcc to the proper LED. Because the 7492 is wired to divide by ten, the scan rate figures out to 100 Hz. This is fast enough to eliminate any flickering, but allows enough brilliance for normal room lighting.

With all new parts, the DSU costs about $6.25.

Decimal Counter Unit

The DCU is constructed on a 3.5" by 1.7" PC board. Except for the first DCU, all use standard 7490s as counters. The first DCU uses the 74LS90 by Fairchild, which was described earlier, for a 50 MHz count rate. Also, each DCU has a 7475 quadruple bistable latch, a 7446 or 7447 BCD to seven-segment decoder, and a socket for the LED. Any Monsanto LED may be used here as the pin-outs for most of them are identical. I used the MAN8, which is yellow, simply because I had them. However, the large .6" MAN6 or the .27" MAN7 will also plug in. Both of these are red.

For the LED socket, use the already preformed side mount socket or be cheap and bend the leads of a wire-wrap socket like I did.

The 7475 is used to transfer the accumulated count of the 7490s to the display when strobed by the Gate Control Unit. A logic one is needed on the clock inputs to transfer the input information. When the clock is low, the latch will store the information until the next

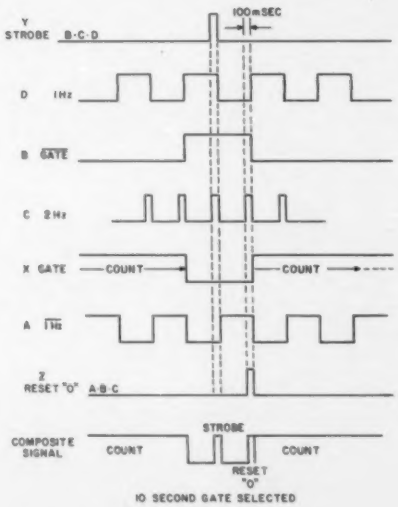

Fig. 5. Gate Control Timing.

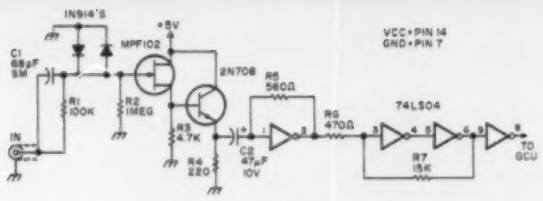

Fig. 6. The Preamp.

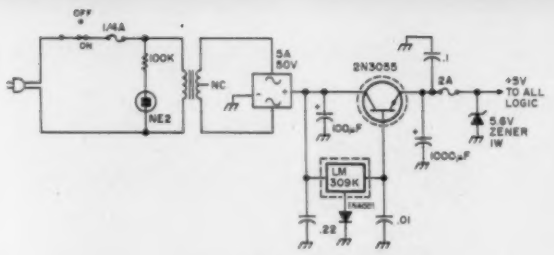

Fig. 7. Power Supply.

strobe pulse. If the input has not changed, the output won't either. If new information is present at the input, the outputs will change to agree with the inputs.

The outputs of the 7475 are connected to the inputs of the 7447 which decodes the BCD to the proper coding to display the corresponding decimal number on a seven-segment readout.

Four of the DCUs have provision for using the decimal point so that the display can be wired to show the frequency in either kHz or MHz. One need only wire the proper decimal point to ground through the gate select switch.

The cost of the DCU will be about $6.50 for the 50 MHz version, and a little less than $6.00 for the standard version.

Gate Control Unit

The original circuit I tried for this was unsatisfactory, as the time needed for the strobe and reset 0 pulses was equal to the gate time. On the faster gates this was no problem, but on a 10 second gate it could be annoying having to wait 20 seconds for updating the display. So I redesigned it with the basic idea that I wanted a 10 second gate and the resets to occur within one second. A look at the timing diagram may help in understanding the operation of this circuit. Refer to the schematic for lettered lines. Note also that the board has a gate LED incorporated on it, eliminating the need to front panel mount one. It will show through the display window to the right of the digits.

The GCU is built on a 3.5" by 1.7" PC board. It consists of four ICs: a 7492, divide by twelve; a 7410, triple-three input NAND gate; a 7402, quadruple two-input NOR gate; and a 74LS00, chosen also for the high toggle speed.

Let us assume we have selected a 10 second gate. Through the gate select switch, 1 Hz and 2 Hz signals are routed to the inputs of the GCU. One gate of the 74LS00 is used to invert the 1 Hz and apply it to the clock input of the 7492. Normally this IC would count to twelve and reset to 0, but with the 7410 gate connected to the A, C, and D outputs, it will be forced to reset at the count of eleven. Zero detecting the outputs with a NOR gate and NAND gate will produce a pulse that is high for 10 seconds and low for one second, which is the time between reset and the next input cycle. Another gate of the 74LS00 is used to invert this pulse.

By combining the inverted gate pulse with the 1 Hz and 2 Hz signals, and then inverting the outputs of the other two gates of the 7410, the Strobe and Reset 0 pulses are generated and transferred to the rest of the counter. Through trial and error it was found that there had to be a minimum amount of time between the two pulses and this circuit provides it. Unfortunately, due to the minimum pulse width needed to reset the 7490s in the counter (50 nsec), the fastest gate time allowable is .001 second. This is probably faster than needed anyway.

The current limiting resistor for the LED should be chosen for the particular LED being used. Generally, about 180 Ohms should be right. Any color may be used; I used yellow to match the display.

This is also the cheapest unit, costing about $4.00 with all new parts.

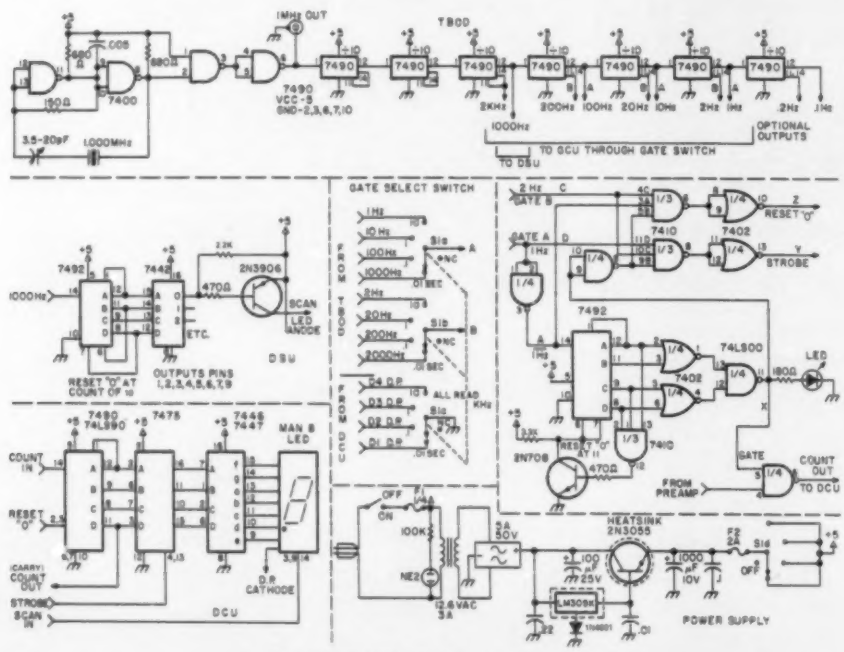

Fig. 8. 50 MHz Frequency Counter.

The Preamp

I finally found a Preamp circuit that would work. I had tried several others that had been published, but had terrible sensitivity. This one I discovered while reading back issues of *73*. It is from the "Latest K2OAW Counter Update" in the May, 1975 issue by WB2UKP. Some minor changes were made, though. I used a 74LS04 to obtain a 50 MHz working speed, a 2N708 for Q2, and a

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TCXO*	2ppm 15 to 55 C
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Resolution:	0.1 second gate
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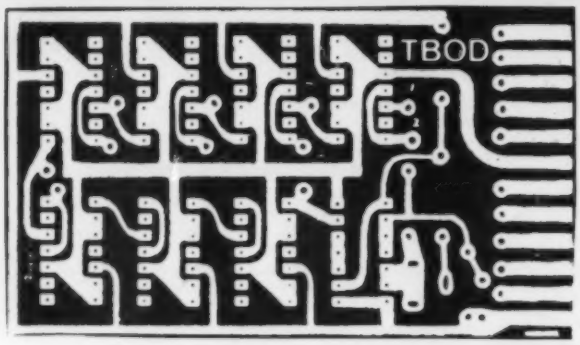

Fig. 9(a). TBOD board (full size).

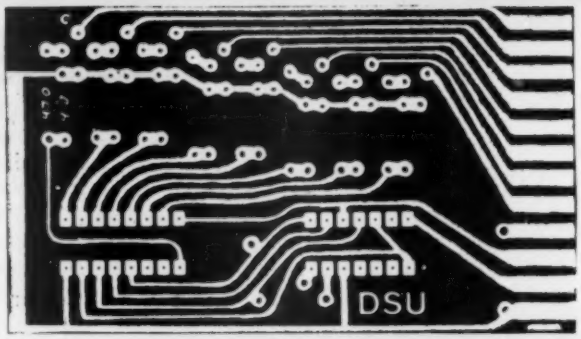

Fig. 10(a). DSU board (full size).

slightly different input scheme. Finally, sensitivity became livable. A scope and rf signal generator (HP 608D) showed a sensitivity of 10 mV from 10 MHz on up. At audio frequencies, about 50 mV was needed for reliable operation.

The reason for all that extra space on the board layout is that I hope to, in the future, incorporate an on-board prescaler using the 11C90 by Fairchild. Provided, of course, that the circuitry is as simple as that using a 95H90. With the 11C90, the counter should operate in excess of 500 MHz.

Power Supply

Due to the heavy current demand, about 1.3 Amps, I decided on the circuit shown to regulate the five volt line, rather than use two LM309s. All components can be mounted on the rear panel with appropriate mounting hardware and solder lugs. Heatsink the pass transistor and LM309K. You can use a bridge rectifier module or individual diodes. They should be rated for at least 5 Amps at 50 volts. The transformer is a 12.6 V ac at 3 Amps, or parallel two smaller rated ones. Use a 2N3055 for the pass transistor or a suitable substitute with similar ratings. The neon pilot light is not really needed, but I like little frills to dress up a front panel.

The fuses should be of the fast blow type. Fuse holders mounted on the rear panel is the best method, but they can be soldered in inside the chassis. The power switch can be eliminated so that the counter is on whenever the line cord is plugged in.

General Construction and Testing

After etching and drilling all the boards, install the jumpers first because two on the GCU are under ICs. Next put in the resistors and capacitors, and then the transistors and ICs. The LED sockets on the DCUs come next; then install the LEDs. Install the sockets on the master board.

Wire the power supply in the case, along with the front and rear connectors and switches. Secure the master board to the case with small angle brackets, at least 4 inches behind the front panel. This will allow the boards to be installed and removed easily. Or the master board may be hinged at the bottom to tilt back. Next do the main wiring from the power supply to the master board and the front panel switches. Use RG-174 for the counter input and the 1 MHz test output. Location of the controls and cutouts is entirely up to the builder and depends on the case used.

Before installing any boards, check the power supply for proper operation. If it's working, turn the power off and install the TBOD in the 12-contact

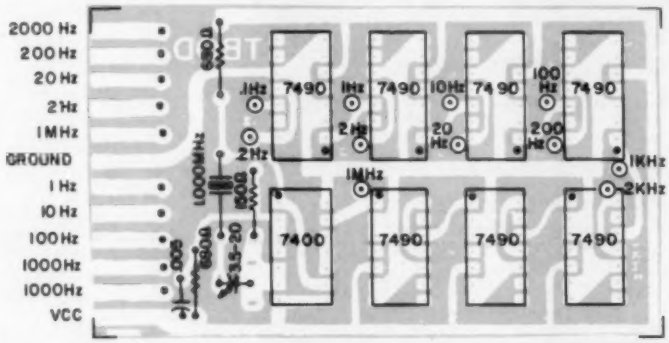

Fig. 9(b). TBOD component layout. Use jumpers to bring frequency outputs to edge. 1 board per counter. Dot indicates pin 1.

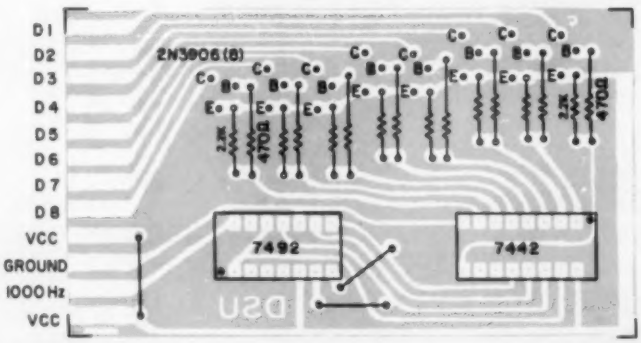

Fig. 10(b). DSU component layout. 1 board per counter. Dot indicates pin 1.

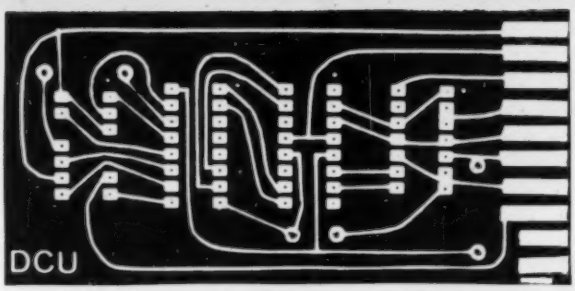

Fig. 11(a). DCU board (full size).

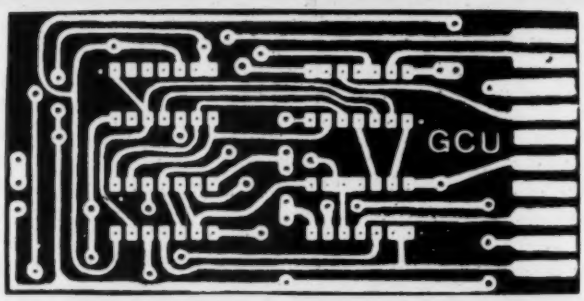

Fig. 12(a). GCU board (full size).

socket on the left (from the front of the counter). An accurate frequency counter will be needed to set the 1 MHz oscillator, at least 1 x 10^{-8}. Turn the power on and with the counter connected to the 1 MHz test output, adjust the trimmer to read 1 MHz, plus or minus a few Hertz. If it won't adjust, try another 7400. This is an initial adjustment. After the rest of the boards are installed, and at least a one hour warmup period, recheck the frequency. Before turning off the power, check the divider chain for proper frequency outputs. If everything checks out, turn the power off and install the GCU board. Select the one second gate and turn the power on. If the GCU is working, the gate LED will blink on for one second and off for 10 msec. Check the Reset 0 and Strobe outputs with a scope for a 10 msec pulse. If the GCU checks out, turn the power off and install the DSU board.

Turn the power on and check each of the DSU outputs with a scope for proper switching. A frequency of 125 Hz should be measured. If the DSU is working, turn off the power and install the DCUs. Turn on the power and check that the display reads all 0s. If not, make sure all the boards are in the sockets tight or check for unsoldered connections, or bad ICs. If all 0s are displayed, turn off the power.

Install the Preamp board and turn the power on. The display should still read all 0s. If not, the DSU may need bypass capacitors on the Vcc line on the master board. Any signal on the Vcc line greater than about 20 mV will trigger the Preamp and cause false counting with no input. Any input signal will have to exceed this by at least 10 mV to be counted. This has been one of my headaches with my counter, although I know I have a bad 7442 in the DSU which is causing the problem.

If you get all 0s on the display, proceed to check out the whole counter by using a signal generator to check the frequency response and sensitivity. You may want to keep a graph or record of the results for future reference. My counter showed a sensitivity of 50 mV from 10 Hz to about 35 kHz, and from 10 MHz on up, about 10 to 15 mV. I didn't have any way to check the frequencies in the middle.

All that's left to do is recheck the TBOD frequency and button up.

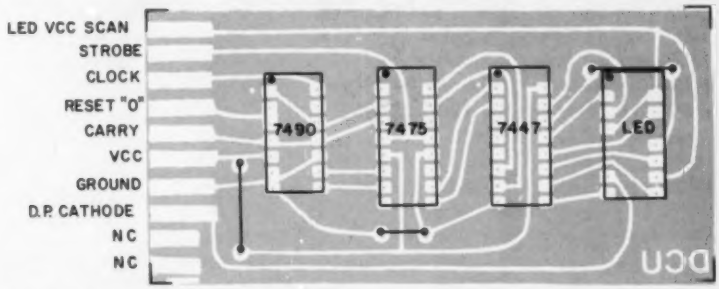

Fig. 11(b). DCU component layout. Use side mount socket for LED (see text). One DCU uses 74LS90 for 50 MHz count speed. 6 or 8 boards per counter. Dot indicates pin 1.

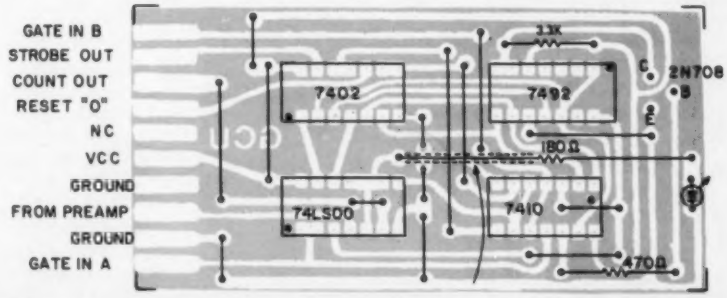

Fig. 12(b). GCU component layout. Use sleeving to insulate resistor lead. 1 board per counter. Dot indicates pin 1.

Troubleshooting

If you run into difficulty getting the oscillator to zero on exactly 1.000 MHz, try another 7400. Some will oscillate better than others. It has something to do with the characteristics of different batches. You can use a scope or another counter to check the divider chain for proper division. On the GCU, a dual-trace scope is nice because you can check and compare the waveforms at more than one point and reference them to another. Most problems here are caused by loose ICs in the socket – for me, anyway. Actually, most problems can be cured simply by trying a different IC. If you still run into difficulty, look for solder bridges, bad connections, wiring errors, or even the possibility of a leaky or bad transistor. Well, what more can I say? Have fun

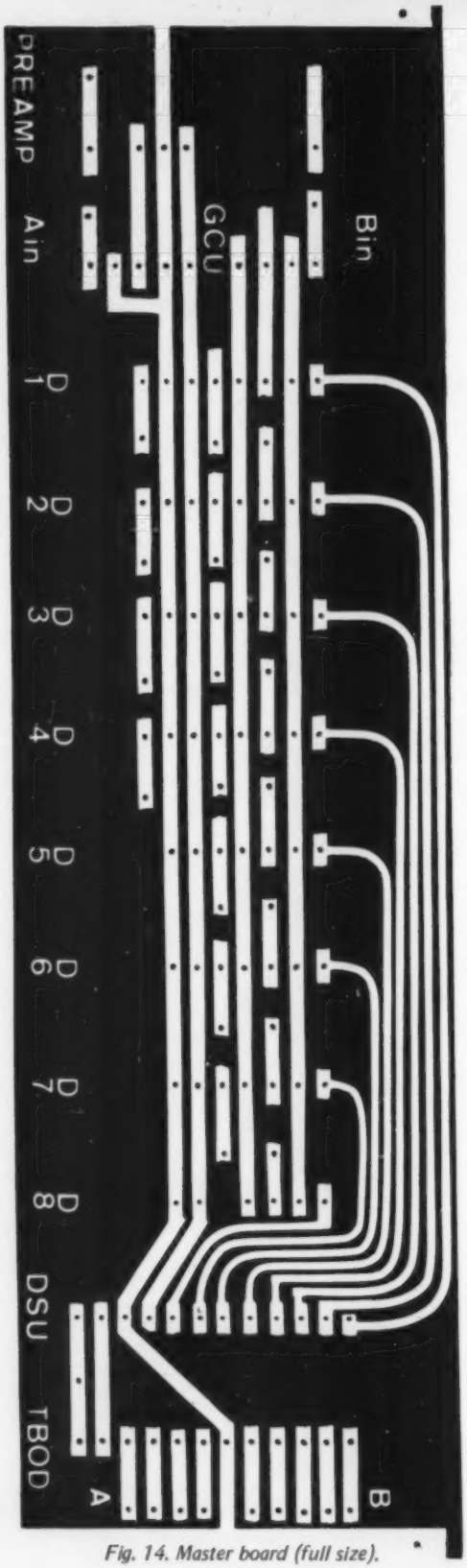

Fig. 14. Master board (full size).

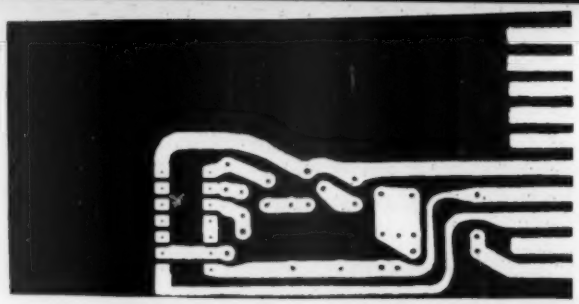

Fig. 13(a). Preamp board (full size).

counting!

Afterthought

One can save in construction costs by not using sockets for the ICs, although it's a good idea to make certain the IC is good first. It's not fun unsoldering them. Do use sockets for the LEDs, though. The preformed side mount ones are best, but a wire-wrap socket will do just as well if you carefully bend the leads with needlenose pliers.

Try for a trade-off between price and visibility on the display. Sure, those large .6" LEDs are easy to read, but expensive. The cheaper, .27" ones will work just as well, and they can be had in different colors: red, green, yellow, or even orange. Check the ads in the back of *73* and I'm sure you'll find something.

The Amphenol PC card sockets are available from Cramer International, Newton, Mass., or the local office in your area.

The cabinet will have to be at least 3½" high, 10½" long, and 7" deep. Make sure you leave at least ½" between the LEDs and the back of the

Parts List for Frequency Counter

TBOD

1	7400
7	7490
1	PC Edge Connector Amphenol #143-012-03
8	14 Pin DIP Sockets
2	680 Ohm ¼ Watt
1	150 Ohm ¼ Watt
1	3.5 – 20 pF Variable E. F. Johnson #274-0020-005
1	.005 uF Disc
1	1.000000 MHz Crystal
1	PC Board

DCU

1	74LS90 (50 MHz Version)
7	7490
8	7475
8	7446 or 7447
8	PC Edge Connectors Amphenol #143-010-03
8	Seven-Segment LEDs (See Text)
8	14 Pin DIP Sockets
8	14 Pin Wire Wrap Sockets
16	16 Pin DIP Sockets
8	PC Boards

Power Supply

1	12.6 V ac, 3 Amp Transformer
1	50 V, 5 Amp Bridge Rect.
1	2N3055
1	LM309K
1	100 uF, 25 V
1	1000 uF, 10 V
1	.01 uF Disc
1	.1 uF Disc
1	.22 uF Disc
1	1N4001

DSU

1	7492
1	7442
1	PC Edge Connector Amphenol #143-012-03
1	14 Pin DIP Socket
1	16 Pin DIP Socket
8	470 Ohm ¼ Watt
8	2.2k ¼ Watt
8	2N3906 PNP Transistors
1	PC Board

GCU

1	74LS00
1	7402
1	7410
1	7492
1	PC Edge Connector Amphenol #143-010-03
4	14 Pin DIP Sockets
1	470 Ohm ¼ Watt
1	3.3k ¼ Watt
1	2N708 NPN Transistor
1	LED
1	@180 Ohm ¼ Watt
1	PC Board

Miscellaneous

Gate select switch, BNC connectors, plastic window, fuse holders, hardware, knobs, cabinet, etc.

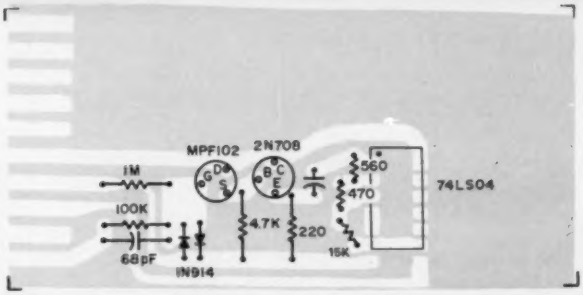

Fig. 13(b). Preamp component layout. Resistors are ¼ Watt. R5, R6, R7 are mounted vertically. 1 board per counter. Dot indicates pin 1.

front panel for removal of the plug-in cards.

If you don't need more than one gate, eliminate the switch and hardware the circuit. The switch I used is a four-pole, five-position, non-shorting miniature rotary, Centralab #PS-11. The extra position and pole made it possible to turn the power on when selecting the timebase.

Also, since I used a new GCU, I found that I could eliminate the last 7490 in the TBOD. Or leave it in if you want an accurate .1 Hz signal for something.

I had a lot of fun designing the counter, but it was not without its headaches. I'm just happy it works. ■

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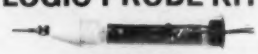

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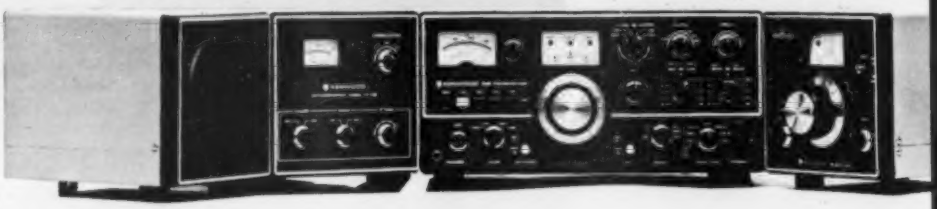

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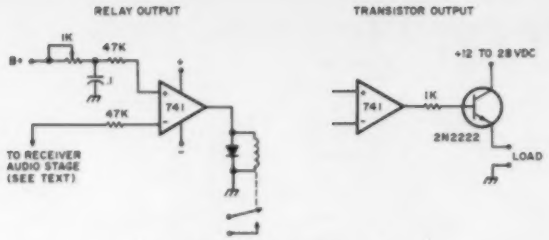

Fig. 1. Universal COR schematic.

The 5 Minute COR

-- simplest yet ?

Steve Uhrig WA3SWS
3893 Juniper Hill Lane
Ellicott City MD 21043

Anybody building a repeater or a remote base needs a carrier operated relay (COR). A COR is a usually simple device that hooks into an FM receiver and closes a relay when a carrier comes in on the receiver. The relay can be used to activate a transmitter for repeater applications or activate any of a number of other devices for special purposes such as tape recorders, meters or alarms. Presented here is what I believe to be the simplest circuit for a COR around. Unlike most other circuits, this one will work on any receiver, vacuum tube or solid state.

This circuit was designed for mobile applications. I wanted something simple, solid state, rugged and reliable. The final draft meets all of these specifications. I have two of these circuits in my car controlling an onboard repeater that will relay 450 MHz to 146 MHz and vice versa. With the repeater installed in my car I am able to use a 450 MHz hand transceiver and work back to the car, firing up my 2 meter mobile with 150 Watts on any VHF channel. This makes the equivalent of a 150 Watt HT with a 5 dB antenna. It works real well, but people I talk to can't understand why they hear 5 squelches drop out.

Now for an explanation of the circuit. The whole idea centers around any old op amp you have lying around (within bounds of reason, of course . . . it works better if the op amp is not burned out). I have had the best luck with either the 741 or the 709 op amp, but several others should work also.

As shown in Fig. 1, the circuit is simple and straightforward. Let's review the basics of how op amps work. Keeping this explanation in mind, the workings of the circuit in Fig. 1 should be obvious to the most casual observer. An op amp is an analog device. In a nutshell, the gain of an op amp (operational amplifier) is very high. Gains of 100,000 to 500,000 are not uncommon. Of course, the output can never go higher than the supply rail, so you can see that an input to an op amp of 1 millivolt will give an output of 10 volts even if you run the gain at only 10,000. Notice the inputs in Fig. 1 marked + and -. These are called the noninverting and inverting inputs respectively. The op amp amplifies the *difference* between these two inputs. In this application for the COR we are using the op amp as a comparator. I will stop here for a moment and give a quick review of the workings of a squelch circuit in an FM receiver. See Fig. 2 for a block diagram of a squelch circuit.

The output of the discriminator will have noise on it when there is no incoming signal present. When a signal does present itself, the noise will quiet. A squelch circuit is designed to turn off the audio stage in the receiver when no signal is present so the operator does not have to listen to the noise. With no signal coming in, we said there would be noise at the output of the discriminator. This noise (ac) is rectified and the dc is amplified by the noise amplifier. The dc signal developed is used to conduct another transistor which in turn shunts any audio present at the audio stage to ground. When a carrier comes in, the noise will quiet. With no noise present at the rectifier in the squelch, no voltage is developed and the audio amplifier operates normally. Now here's where our carrier operated relay does its thing. Hang a voltmeter across the emitter-collector junction of the audio amplifier transistor. With the stage off, there will be a difference in current flow and therefore voltage across this junction.

Notice the inverting input of the op amp in Fig. 1. This input is hooked directly to

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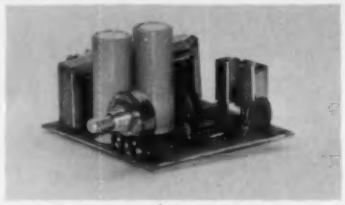

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the collector of the audio amplifier preamp transistor. You can see now that there will be a higher voltage on this input when the transistor is turned off than when it is amplifying. The non-inverting input of the op amp is tied to a reference voltage, in this case B+. The reference voltage will remain constant, but the voltage on the other input will shift when a carrier comes in on the receiver and turns on the audio stage. The op amp will amplify the difference and drive the output to the full supply rail voltage with as little as 1 millivolt between the inputs. The output voltage can be used to trip either a low current relay or it can turn on a transistor. I used a reed relay, but any type with a coil current of less than 75 mA is acceptable. Check the specs on your particular op amp before using anything that might draw this much current. Under no circumstances draw more than 100 mA from the op amp.

The 1k pot on the non-inverting input of the op amp sets the reference voltage. The setting here will depend on where and how you hook the op amp to the receiver audio stage. Set it so the COR trips reliably on an incoming signal. Try to keep this voltage as low as you can and still keep the circuit operating properly. The 47k Ohm resistor limits maximum current on the input. There are probably about six places where you can tie the inverting input of the op amp to the receiver. Anywhere you have a voltage change between signal and no signal will work. If it doesn't work the first time, swap the leads to the + and - inputs. It may be that you have picked a point where the voltage swings in the wrong direction. Don't leave out the diode across the relay coil. When the relay opens up, there is a big voltage spike that could damage the op amp if the diode wasn't there to shunt it.

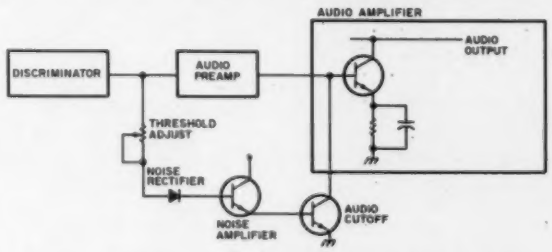


Fig. 2. Block diagram of squelch circuit for FM receiver.

Another interesting use for this COR besides repeater applications is to use it to inhibit a clock on a scanner. Use the transistor output and when a carrier comes in on the receiver you can kill the clock and lock the scanner on that frequency. When the carrier drops, the clock will start up again and resume scanning. It is possible to put a capacitor in the circuit to delay the transistor shutting off immediately if you should want the scanner to wait a few seconds so you don't miss any possible reply on the channel that was just active.

Well . . . here you have it. Construction is simple. I build my versions on the little printed circuit boards available from Radio Shack. They're a convenient way to do it and are small enough to fit in anything larger than a TR-22. If you desire to use the COR on a vacuum tube receiver, build a voltage divider on both inputs to keep the operating voltages around 15 or 20 V dc. Voltage from the push to talk line should be of acceptable quality to power the op amp if you filter it a little bit.

There are lots of uses for CORs. They're a lot of fun to play with. ■

Gerald J. Hargett
Pinefields Farm
Route 2, Box 68-E
McComb MS 39648

See the World and Get Paid!

- - merchant marine radio officers: part II

For illustration we will follow a radio officer through a routine departure. His ship, *SS Valiant*, is a tanker making a transit from the port of Houston, Texas to the port of New York, New York. This trip normally requires a little over five days. Our radio officer, "Sparks," is a conservative, thorough individual. Often this radio officer's meticulous logkeeping goes beyond the absolute minimum regulation compliance. By being overzealous, "Sparks" hopes to avoid "sloppiness" on essentials. As is the custom, our radio officer is on board the vessel one hour before posted sailing time. Since the *SS Valiant* is a tanker alongside the terminal, transmitter testing is not permitted. However, the other items in the pre-departure routine can be checked and logged. This pre-departure testing is neatly typed in the log and signed with the testing time. The log resembles the following:

4-25-75
1400GMT – Pre-departure tests, Houston terminal. Main and emergency receivers work properly; B battery voltage 88 V dc under load; ship's line 118 V ac; emergency battery specific gravity 1278, batteries on continuous trickle charge of proper polarity; auto-alarm checks OK – keys after 4 spaced dashes; alarm keyer functioning normal; speaking tube communications to the bridge operable; radio room emergency lights burning normally; antennas visually checked and apparently in good order. Transmitters will be tested away from dock and radiation noted (antenna current). Radio room clock checked against WWV, 3 seconds fast/corrected. All publications and required spares on board. Tester ... (signed)

Once the vessel is cleared of the dock, main, emergency and lifeboat transmitters will be tested. The main transmitter will generally put twelve or so rf Amperes into the main antenna; the emergency, approximately three to four rf Amps.

Since it is several hours to the sea buoy (departure point for the sea passage), the radio officer is free of watch standing duties. Sea watches in the radio room are from sea buoy to sea buoy. Some companies require watch standing on long river transits. Whatever is in the contract will be implemented. "Sparks" will copy a weather broadcast from Galveston radio, KLC, at 1730 GMT. This will contain Gulf of Mexico weather data. Radio officers endeavor to copy weather "ahead" so the captain can be made aware of wind and sea conditions. This information enables the master to plan the most direct and safest routes; it also allows for more accurate estimated time of arrival (ETA) messages.

At 1900 GMT the ship drops the pilot and takes departure. The radio officer begins watch standing. The log is signed noting that a listening watch on 500 kHz is in progress. Every fifteen minutes a log entry is made of noted exchanges which occurred during that period. Silent periods (15-18 and 45-48 minutes past each hour are designated quiet listening segments for any distress signals) are logged as having been observed and as to whether or not signals were copied. At times the circuit will be quiet with no exchanges occurring during the fifteen minute segment – this fact is so logged. Under a plexiglas on the operating position are schedules of traffic lists, weather and hydrographic bulletins, station frequencies and other pertinent data. These schedules are kept when applicable. From experience "Sparks" knows that the bulk of company traffic is handled through Port Arthur radio, station WPA. By following WPA's schedules very closely, messages are often received minutes after they are filed.

As the ship gets under way, the captain will have time to prepare the routine departure messages and reports. These are then given to the radio officer who will process them. This involves counting words, noting filing time and date, proper addresses, etc. The radio officer then transmits the messages to the appropriate station(s). Once cleared, the messages are typed on formal cablegram blanks and filed for end of month processing. The master is given the original copy. One copy is filed for the company to receive, and another copy is sent to the radio agency for abstracting (computation of charges).

Suppertime comes and goes. After a brief recreation chess match with one of the off duty mates, "Sparks" is ready for the evening watch. Weather is again copied updating the earlier report. Traffic lists are checked for close of business day messages which often are filed. The log is kept current. At 9 pm ship's time the watch ends. Our radio officer sets the auto-alarm. This fact is noted and the log is signed out.

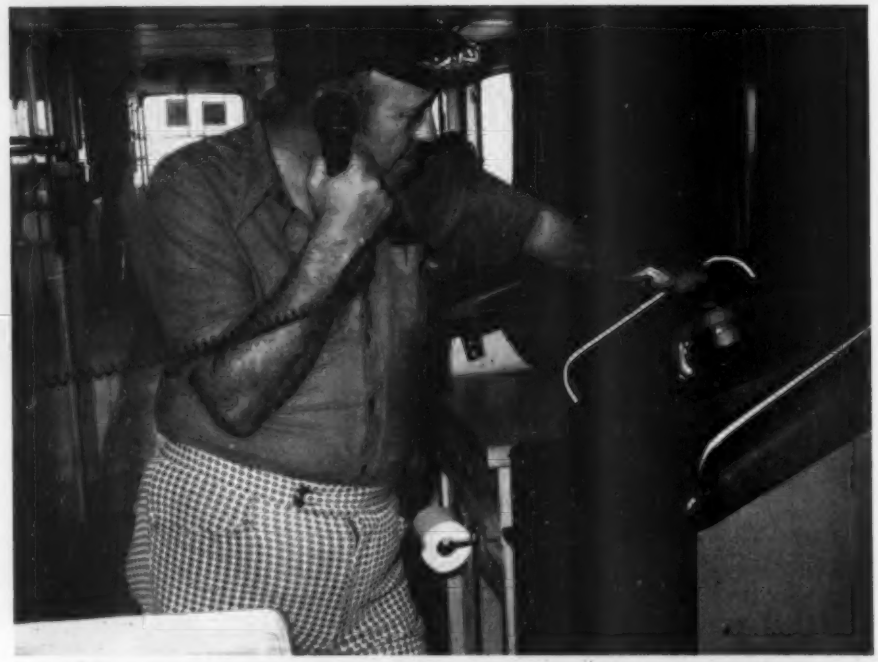
This ebb and flow of routine matters allows the voyage to New York to pass quickly. The radio officer may be asked to check the radar or loran or DF, minor problems may develop in one of the receivers or transmitters, or orders may be received to proceed abruptly to some other destination. Each day brings its own challenges. After eighty days on the tanker, the radio officer will be relieved for forty-five days paid vacation. This time will be used to rest up from the sea routine. Perhaps "Sparks" has some budding business interests – a farm or rental properties to attend, or some recreational development. Some radio officers simply enjoy spending a large amount of time off with the family. Whatever the preoccupation, the time passes once again and "Sparks" will be notified to report back to the same or some other vessel. The radio officer will bring his or her growing electronic knowledge and experience to bear once again on any situation the next eighty days on shipboard will bring.

Photo courtesy of Gene D. Legler, Editor, *Exxon Fleet News*, Exxon Company, U.S.A., Houston TX.

Traffic Handling

Traffic, messages sent and received, take up a good portion of a radio officer's watch time. Commercial operators have always prided themselves in their ability to handle a large volume of traffic with dispatch. The commercial operator is trained to copy with one hundred percent accuracy exactly what he hears. Most operators become proficient enough with the typewriter to almost sign their names. When one considers the high costs of operating oceangoing vessels today, one appreciates the need for accuracy in messages. Costly cargo operations, tugboat standby time, or overtime for repair people can all be the direct result of inaccuracies in cables. That is one reason every commercial operator carefully checks a received message for word count before acknowledging (QSLing) it.

The ability of commercial operators to handle traffic well is due in part to standard operating techniques. Crisp, snappy Morse exchanges with no superfluous sending are the key to professional radio operating. For those not familiar with commercial procedures a contact will be briefly outlined. Ship station KAVQ wants to send traffic to coast station WPA, Port Arthur radio, using the 12 MHz band. The radio officer tunes his receiver to WPA's marker frequency (12840) and then calls on KAVQ's calling frequency (duplex operation). Station WPA is constantly scanning the calling band. Rigid FCC rules must be adhered to regarding length and spacing of calls. WPA hears KAVQ calling and communication is established. The ship station will change (QSS) to the FCC assigned working frequency after advising WPA which this is so Port Arthur can tune its receiver to KAVQ's working wave. Once QSS is accomplished and communication established, KAVQ asks WPA, "QRV?" (Are you ready to copy?) WPA sends K and KAVQ responds as follows (a



"dummy" message for illustration):

```
- . - . - (BEGINNING SIGNAL)
MSG NR 1 SS STAR CK8 16 1423GMT BT
KESTAR NEW YORK BT
ETA 18TH 0500 REQUIRE 2000 BUNKERS BT
AR
```

Examining this message we find the following:

Preamble: Consisting of message class (MSG), number (1), word check (8), date (16), and time (1423 GMT) of filing. A BT is sent signifying to the receiving operator to throw the carriage of the typewriter as a break is needed.

Address: This is usually a cable address such as "Keystar" followed by the name of the city in which addressee is located (New York). Again a BT signifies a break.

Text: The actual message itself. Followed by BT.

Signature: Not always contained in cables.

In counting words, each word in the address, text, and signature is counted. As an operating aid the signal AR is sent at the end either of the text after BT or after the signature to indicate the end of this particular message. If another message is to follow, the operator will simply send the class designation after the AR. For example, after AR the radio officer will send NRT to indicate another message of the NRT type will be sent. The coast station will acknowledge with a "QSL" and indicate a "K" or "QRV" to let the sending operator know the next message can be sent.

When the coastal station has a message the same format is followed. In place of the ship's name in the preamble will appear the city of message origination. Rather than a cable address, the message will be addressed to the vessel; usually the master's title will precede the vessel's name. Thus:

```
- - - -
MSG NR 1 NEW YORK CK 7 18 2200GMT BT
MASTER, SS STAR BT
BUNKERS ACKNOWLEDGED CALL OFFICE SOONEST BT
AR
```

Traffic handling facility is acquired through practice. Time spent listening to top professional commercial operators at the busier marine stations (WCC, WSL, JCS, etc.) is a good investment. With experience the beginning radio officer will appreciate the skill involved in apparently simple, efficient exchanges of Morse. The master operator sends not one unnecessary dot or dash.

Mechanics of counting words (doubles, tripies, etc.), assigning prefixes, and routing messages is acquired through usage and imitation of accepted commercial practices. ITT Mackay Marine has a comprehensive "Radio Officer Manual" which details message processing as well as a wealth of other information. All ITT Mackay contract ships have a copy of this text. RCA has a similar publication on its contract vessels. With practice and attentive listening, a new radio officer will soon become proficient in traffic handling.

Standard Shipboard Publications for the Radio Officer

All licensed shipboard installations are required to have on file the following publications in order to meet with full FCC compliance. Required documents are included in the list.

1. Valid station license.
2. Valid operator license.
3. Required station logs.
4. Alphabetical list of call-signs of stations used by the maritime mobile service – current edition.
5. List of ship stations – current edition.
6. List of coast stations – current edition.
7. List of radiodetermination and special service stations.
8. Manual for use by the maritime mobile service – ITU Geneva.
9. Part 83 of FCC Rules and Regulations.

With the above reference publications, the ship may go any place in the world and the radio officer will be able to locate appropriate coastal stations, their schedules, tariffs, routings, time ticks, and other needed data. A few explanatory paragraphs will be given regarding the publications and documents.

1 and 2. A valid station license is extremely important. The radio officer should inform the master if the license is nearing expiration. Heavy penalties are incurred for invalid licenses. It is assumed the radio officer's licenses are current and posted.

3. Station logs as well as other required stationery are usually supplied by the contracting agency. Message blanks, requisition forms, and work orders are all supplied by the husbanding radio contract company. Other normal stationery items (pens, pencils, notepads, etc.) are supplied by the particular steamship company. The radio officer is responsible for keeping the inventory at reasonable levels: usually six months of supplies are considered adequate.

4. A quick reference manual for identifying ships or coastal stations from their assigned call letters. New editions are constantly being published to keep the radio officer abreast of changes.

5. This is a more elaborate manual (over 500 pages) listing ships alphabetically by name. Pertinent data is given for each ship: type of equipment (telephone, telegraph, etc.), hours of service, ship classification and other useful information concerning the communications ability of the vessel. The present edition contains information on over 52,000 stations.

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important and useful publication. It gives the radio officer a tool which can direct him or her to unfamiliar ports of call. The list contains pertinent information on coastal maritime stations around the world. It is republished every two years; supplements are issued every six months. This manual contains three parts: a. Alphabetical index of coast stations; b. Full particulars of each station – frequencies, operating times, traffic listings, particular communication procedures; c. An annex which gives inland telegraph rates, tariffs, and other monetary information. Once a radio knows the vessel's itinerary, this publication can be consulted and schedules planned.

7. The manual of radiodetermination and special services can be considered the next in relative importance. Part A of it gives an alphabetical index of all stations listed. Part B gives the particulars of these stations. The most useful of these are the areas of radiodetermination (direction bearing stations), time signal information for accurately setting of chronometers, and stations dispensing medical advice. The publication is complete and comprehensive. The present edition contains 750 pages.

8 and 9. These publications contain regulatory matter. The first has chapters on internationally agreed regulations and procedures; the second contains the Federal Communications Commission's regulations for the Maritime Mobile Service. These are excellent operating aids.

Besides the above publications, each radio room will have on file the various operating and technical manuals covering the electronic equipment installed. These represent invaluable service tools and maintenance aids. They give prints, upkeep information, parts nomenclature, troubleshooting procedures, and correct operating techniques. Almost any repair situation can be solved through judiciously studying the manual. If an exact remedy cannot be found, the general area of fault can usually be determined – information helpful in ordering shore repairs.

Basic Electronic Maintenance

Newly documented radio officers channel their efforts at first to learning the "radio operating" aspect of the profession. However, it will soon become evident that more is expected of a ship's radio officer. As indicated in other sections, the actual operation of the radio station becomes routine with experience. A radio officer's other responsibility is the proper maintenance of the station as well as other electronic equipment within his or her ken. In addition to the receivers, transmitters, power supplies and chargers located in the radio room, a competent sparks also will keep in proper operating order the radars, loran, direction finder, recreation shortwave receivers, and televisions on board the vessel. A person who can handle this varied array of equipment, keep shoreside repair bills to a minimum, and obtain maximum performance from the communication and navigation gear is much sought after by companies and captains alike. This section will delve into some very basic concepts of shipboard electronic maintenance. The subject is an exhaustive topic and spans the life and career of each radio officer.

All electronic equipment contains normally a combination of electronic circuitry and mechanical movements (dials, drives, relays, multicontact switches, etc.). While this apparatus is designed to operate in a vigorous salt air environment, the pounding of the ship, exposure to heavy humidity, and operation by many individuals all take their toll on equipment performance. One simple, basic preventative maintenance program is to keep the equipment clean of salt and corrosion. Wiping surfaces, cleaning and lubricating contacts, burnishing pitted relays, lightly greasing cams, gears, chain drives, reseating tubes and crystals to remove any corrosion from forming on pins – all these elementary procedures will contribute to optimum operation of electronic gear.

Electronic apparatus employing high powered electron tubes can be disabled through a simple filament break in one of the high temperature tubes. This is a basic defect to investigate when this type of equipment fails. Power transistors are subject to the same type of thermal punishment and often open or short under such pressures.

Electronic troubleshooting requires organized logical thinking. No matter how complex the unit to be serviced, it contains the workings of the three basic electronic circuits: rectifiers, amplifiers and oscillators. If a person has a sound grasp of the operation of these circuits, the defective element (resistor, coil, capacitor) can often be pinpointed through simple voltage and resistance measurements. The prints contained in the manuals offer clues as to what proper readings should be found. Any wide deviation from suggested call-outs in an electronic print should alert the radio officer to seek reasons for the deviation; often the "reasons" will be the faulty component located.

As with radio operating, one becomes proficient in basic maintenance and troubleshooting of gear with experience. Certain faults will occur over and over. Eventually symptoms will be immediately recognized and the fault will be rapidly repaired. Many radio officers work at one time or another at repair depots ashore. These are either electronic maintenance companies, television repair facilities or two-way radio repair terminals. This shoreside experience is valuable. Techniques are developed which speed servicing. Much can be learned from senior technicians with many years of experience. These people are usually more than willing to share their experiences with beginners.

It is well to note at this point that radio officers receive base wages for the eight hours (normally) watch standing. All repair/maintenance work is additional compensation earned outside watch hours. Shipping companies have found even with the overtime paid they still are ahead economically. Large service companies of necessity charge high rates. They may have to travel long distances, wait hours for delayed arrivals, and in general contend with costly overhead expenses.

With advances in modern day technology, satellite communication capabilities, and automated telex (unattended) terminals installed aboard ships, it is very possible that international and national regulations will be amended some day possibly eliminating the traditional role of radio officer as presently known. However, it is the consensus of all those knowledgeable in shipboard manning policies that a place will always be available on a vessel's articles for some type of "electronic officer," a person (male or female) who can cope with sophisticated equipment and effect repairs necessary to keeping communications "alive" between the vessel and shore. No one will venture how far into the future this situation will materialize. However, the technology is available today. Regulatory agencies, however, require lengthy periods to legislate major changes. The person who keeps aware of advances in communication electronics, broadens his or her electronic expertise

through study and application, and brings a common sense practical troubleshooting approach to repair situations has taken positive steps to enhance his or her worth to the company and keep the job secure.

Goals

It is hoped that the reader has found helpful information in these pages. I have attempted to bring together material aimed at positive means of joining the ranks of radio officers. As in many narrow specialties, it is difficult to "break in" the profession of radio officer. The rewards as hinted are ample for those who pursue the necessary courses of action to qualify. The opportunities are open to both men and women. Foreign flag vessels have employed female radio officers for years. Many of these women, in addition to sending beautiful commercial CW Morse, are competent electronic technicians.

As in any profession one encounters the excellent, the mediocre, and the incompetent. Anyone seriously endeavoring to embark on a seagoing career as a radio officer is wholeheartedly encouraged to strive for excellence in performance. Conscious awareness of sending good CW, meticulous log-keeping, faithful performance of required tests, error-less copies of messages, weather reports, hydrographic bulletins – all these mark the truly professional radio officer. After becoming settled in commercial radio operating, further study to acquire the radar endorsement on one's license will enable the holder to perform more complex maintenance on these units. Passing the higher code test after a full year's service is acquired will grant the radio officer the first class radiotelegraph license, the apex in certification. Proficiency in repair and maintenance of electronic equipment will bring additional financial remuneration as well as a gratifying sense of technical achievement.

A sincere "73" and best of luck. May your efforts toward becoming a Merchant Marine radio officer be crowned with success. ■

APPENDIX A

Maritime Station Information
Traffic Lists
Weather Schedules
Selected Operating Frequencies
All Time GMT

TRAFFIC LISTS: Odd Hours
WSC (Tuckerton NJ) 19 past
WPD (Tampa FL) 20
KLC (Galveston TX) 30
WHM (Baltimore MD) 30
WAX (Ojus FL) 35
WSL (Amag NY) 50
KPH (San Fran CA) on hour
KFS (San Fran CA) 30

TRAFFIC LISTS: Even Hours
WLO (Mobile AL) hour
WOE (Lantana FL) 05
WPA (Port Arthur TX) 18
WNU (Slidell LA) 35
WCC (Chatham MA) 50
KHK (Hawaii) 30
KOK (Los Angeles) 50

WEATHER SCHEDULES:
Gulf of Mexico
KLC 0530Z/1130Z/1730Z/2330Z
WLO 1300Z/2300Z
East Coast Weather
WSL 0500Z/1100Z/1700Z/2300Z
West Coast Weather
KPH 0500
KFS 0420
KHK 0530

Time Standards (for chronometer settings):
WWV/WWVH 5 MHz/10 MHz/15 MHz/2.5 MHz
CHU (Ottawa, Canada) 3330 kHz 7332 kHz 14670 kHz

Selected Marine Station Frequencies in kilohertz:

WPA	416	6435	8555	12840
WCC	436	6376	8568	13033
KLC	484	6360	8666	13038
WLO	438	6446	8722	12704
KPH	425	6467	12808	
KFS	436	6365	12844	
KHK	484	6407	13029	
WNU	478	6495	13826	

Mediterranean/European Major Stations
Traffic Schedules:
Odd Hour
GKU (London) on hour
SAG (Sweden) on hour
PCH (Holland) 5 past
OST (Belgium) 10 past
DAN (Germany) 30 past
Even Hour
SVA (Athens) on hour
LGW (Norway) on hour
OST (Belgium) 10 past
FFL (Paris) 30 past
CUL (Lisbon) 30 past

Frequencies for above stations found in frequency list.

Pacific and Far East Stations
Traffic Lists:
NBA (Balboa, Panama Canal Zone) odd hour
JOS (Chosi, Japan) 30 past odd hour
HLP (Pusan Korea) 30 past odd hour
JSC (Japan) even hour
KUP (Okinawa) even hour
DZG (Manila, PI) 20 past even

Hydrographical information is sent by station NAM, Norfolk VA. Broadcasts throughout the day. The 1700 GMT schedule contains information for Mariners. Frequencies: (in kHz) 88 5870 8090 12135 16180 20225 25590

Stations use their medium wave through twelve megahertz bands adding higher frequencies when propagation is open.

APPENDIX B

Employment Sources

There are two national maritime radio officer unions. Each of these unions has branch offices in all major port cities of the United States as well as keeping headquarters located in New York City.

The first of these two unions is the *American Radio Association*, an AFL-CIO affliate. This union has numerous companies under contract: Lykes Brothers Steamship Company, Keystone Tanker Company, and American Export Lines, to mention only a few. Additional information can be acquired from either the headquarters in New York or any of the many branch offices located around the country. A person shipping via a union hall usually registers at the office nearest his or her home as transportation reimbursement will be calculated to and from this point.

Of interest to radio officer aspirants is the Free Press which the American Radio Association (ARA) sponsors each Sunday at 1818 GMT. ITT Mackay station WSL, Amagansette, N.Y., transmits this weekly Press on frequencies (in kilohertz) 6414, 8514, 13078, 17021 and 22485. Items in this Press concern maritime happenings of the past week. Special interest is shown in this press when new contracts are pending; complete details are generally sent.

The second national radio officer union is named, appropriately enough, *Radio Officer's Union*. This union also has branch offices in major port cities. Companies which utilize men from the

ROU, such as Mobil Oil, Delta Line, and many others, depend upon the union to recruit enough members to fill any vacancies which occur.

Government agencies responsible for crewing of specialized vessels represent an excellent source of employment. United States Coast and Geodetic Survey vessels hire qualified civilians. These ships make fine berths for a person to enter commercial radio operating. One may even opt to remain as a civil service employee as a career. Generally the pay scale on such vessels is lower than on other commercial ships. Thus a large turnover in manpower is ordinarily experienced. Military Sealife Agency (MSA), with offices in New York and San Francisco, concentrates its efforts using civilian crews to operate vessels which carry exclusively military cargo items. The Corps of Army Engineers occasionally requires radio officer personnel on its large offshore dredges and supply boats.

Private research and oceanographic companies generally hire radio officers for upcoming projects. Herein lies potential employment leading to the six months' endorsement, as many of the research vessels are voluntarily equipped. Texas A & M University operates one such vessel. The Woods Hole, Mass. project has its project ship. Inquiry can be made of oil consulting firms which operate survey type boats requiring the services of radio officers.

Besides the national unions for radio officer registration, many smaller steamship and tanker companies hire individuals without union affiliation. Most of these "independent" companies do have "independent" or company-organized unions with membership optional. Such companies are Hess Oil, Sabine Tankers, Exxon U.S.A. Tankers, Sun Oil, and many others. Inquiries of one of these companies will generally glean "leads" to other companies who hire independent of union affiliation. Time spent researching the yellow pages of the phone directory of any large port city will lead to positive and plentiful potential employment sources.

APPENDIX C
Types of Equipment

Any licensed United States Maritime Mobile Radio Station is required to have certain minimum equipment to satisfy compliance with FCC regulations. Compulsorily equipped vessels generally will have the following electronic items in the radio room:

Reserve Receiver: This can be operated from battery supply voltages in an emergency. Frequencies covered by this receiver must be in the 15 kHz through the 650 kHz spectrum. Most older installations use superrengenerative receiver circuitry. More recent installations use low power consuming transistorized heterodyne principles.

Main Receiver: This is generally an extremely well built double or triple conversion superheterodyne circuitry receiver which operates off the ship's mains. Modern RCA and ITT Mackay receivers cover 80 kHz through 30 MHz in numerous bands. For convenience, each band usually tunes a 500 kHz segment of the band desired at a time. The RCA 8516 model is one example of a modern shipboard general coverage receiver. All modes (AM, CW, SSB) of reception are included as well as a variable bandwidth to help copy signals on crowded bands. The ITT Mackay 3010C has become a standard of excellence for shipboard receivers. It is rugged, stable, versatile and costly. Made to rigid commercial specifications, this receiver gives years of service with minimum maintenance. Terminology varies regarding the "reserve" and "main" receiver concepts.

Main Transmitter: These installations cover 400 through 535 kHz and range in output power from 200 Watts to a thousand. The more common main transmitters put 250 to 500 Watts into the antenna. Both A1 and A2 emission modes are contained in the units. Output configurations of these transmitters enable a wide variety of antenna types to be used. Most popular is the longwire and vertical (top hat) loaded antennas.

High Frequency Transmitter: These installations are the units which usually get the "communicating" done over long distances. It is quite normal to consistently "work" home stations halfway around the world. These HF transmitters generally cover 2 MH through 24 MHz. Crystal controlled oscillators eliminate off frequency excursions. Generally a ship will have two calling frequencies and two working frequencies in each of the harmonically related marine bands of 2, 4, 6, 8, 12, 16, and 22 MHz. Thus a potentially large number of channels are available for needed communications. Emission of the HF transmitters is A1; however, some units combine AM telephone operation permitting A3 operation in allocated bands. The FCC has legislated that no amplitude modulation be permitted after 1977. Ships will then be required to use the suppressed carrier single sideband transmission mode. Many ships today are SSB equipped for its excellent communication ability.

Reserve Transmitter: Like the reserve receiver, this must be capable of operating off emergency battery voltage. These units cover 350-515 kHz using A2 emission with output power in the 50 Watt range. Versatile antenna networks allow matching of even random wire lengths should critical situations require this.

Auto-Alarm: The purpose of this device is to stand a watch on the distress frequency when the radio officer is unable to either because he is off cuty or because of other extenuating circumstances. The international alarm signal consists of a series of dashes four seconds in length, separated by spaces having a duration of one second. Auto-alarms designed to meet FCC specifications are arranged to actuate an audible alert (bell) when four correct dashes and spaces have been received. Modern alarms utilize transistor circuitry achieving high reliability. Older alarms, through a system of stepping relays, require more maintenance to keep the mechanical system operative. The auto-alarm receiver covers 492 to 508 kHz. Nominal standard signal is of 50 microvolts.

Auto-Alarm Keyer: This unit is operated in conjunction with the main transmitter and will send out, mechanically, the appropriate alarm actuating signals. Standard procedure is to send the keyer signal for a minute followed by the SOS message.

Battery Charger(s): The radio officer is responsible for keeping the emergency batteries in a good state of charge (specific gravity of 1278 or so). Battery charging devices are part of most consoled equipment which can be manually or automatically operated.

That is the very basic radio equipment found on compulsorily fitted vessels. More elaborate installations will include VHF/SSB/AM radiotelephones, facsimile receivers and machines, radioteletype equipment, and perhaps satellite communications facilities.

Bridges of vessels are fitted with sundry electronic devices. Loran, omega receivers, Decca navigator gear, ten and three centimeter radars, collision avoidance computer systems, autopiloting systems, and remote radiotelephone installations

are some of the more complex items found on modern day vessels.

APPENDIX D

Antennas

A moot question often develops among radio engineers: What is more important, a higher powered transmitting system or a redesigning of the antenna system? This answer will not completely satisfy both parties but is sufficient for discussion purposes here: The better the radiating facilities connected to a transmitter, the more economical and efficient use is made of the power required to produce increased output. Thus, shipboard antennas are very important devices which require special consideration.

Earlier shipboard radio history details that simple longwire antennas worked efficiently for the medium frequencies being generated. Even today the best radiator for the 400-500 kHz band is a good longwire stretched as far as possible between two points aboard the vessel. Ships with such longwires work coastal stations at far greater distances then sister ships equipped with verticals. However, once high frequency transmission became commonplace, the vertical antenna proved to be an excellent device for shipboard installation. Rugged and efficient, a vertical cut for the 8 MHz band and properly loaded for others can effect around the world communications when linked to a transmitter in the 200-500 Watt output class. In special class vessels where longwires cannot be located, the verticals are coil loaded to resonate on the lower frequencies. This is inefficient and the range of communication diminishes. Most ships will have a combination of longwire(s) and vertical antennas to take advantage of the inherent characteristics of each.

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If you've ever seen or used a spectrum analyzer, you know how valuable they are. After calling CQ you can see the signals replying without touching the receiver. When chasing DX you can see the weak signal before hearing it and therefore tune more carefully. An analyzer is useful for finding clear spots in a crowded band or weak signals in a quiet band.

Connecting the analyzer to your receiver is no problem. The analyzer input signal is obtained from the plate of the first mixer stage of the receiver. The frequency response at this point is quite broad and enables the analyzer to view as much as 100 kHz of the band.

Unfortunately, some amateur and general coverage receivers change mixer output frequencies for different bands (as shown in Fig. 1 for the Hammarlund HQ-180).

With this type of receiver, either 2 spectrum analyzers must be used, or one analyzer to cover only a portion of the receiver tuning range, or one analyzer with an external converter. With cash output already exceeding income, the XYL was not exactly happy about buying another analyzer. Having used the analyzer on the high bands, I was lost without it on the low bands. I therefore decided to build an external converter to convert the low band i-f up to the high band i-f required by the analyzer (as shown in Fig. 2).

The oscillator is not critical, but should be crystal controlled for stability. However, I was reluctant to spend any money at all, and the receiver just happens to have a crystal oscillator which isn't doing anything when the receiver is tuned to the low bands. With the addition of a ½ Watt resistor, I now have my oscillator, and if the mixer is passive, no external power supply is required. Granted, I now have a "birdie" at 2.58 MHz, but so what. It's not in an amateur band or a broadcast band and there isn't anything else.

The completed circuit is shown in Fig. 3. It's simple, it works, and best of all, it's cheap. Resale value is not noticeably affected so long as the extra 22 kΩ resistor is removed prior to sale.

Construction was not critical, except keeping the input away from the output. The diodes can be almost any decent switching type, but should be germanium (hot carrier diodes might be an improvement). The input transformer is normally used as an FM descriminator and is therefore quite broad-banded. The output transformer primaries should be balanced. ■

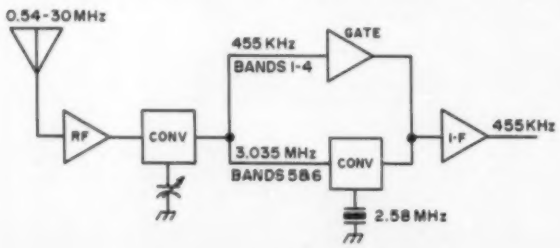

Fig. 1.

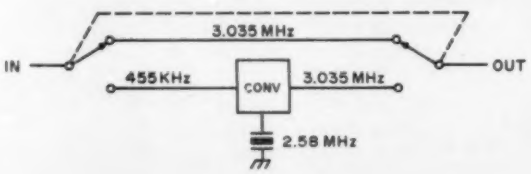

Fig. 2.

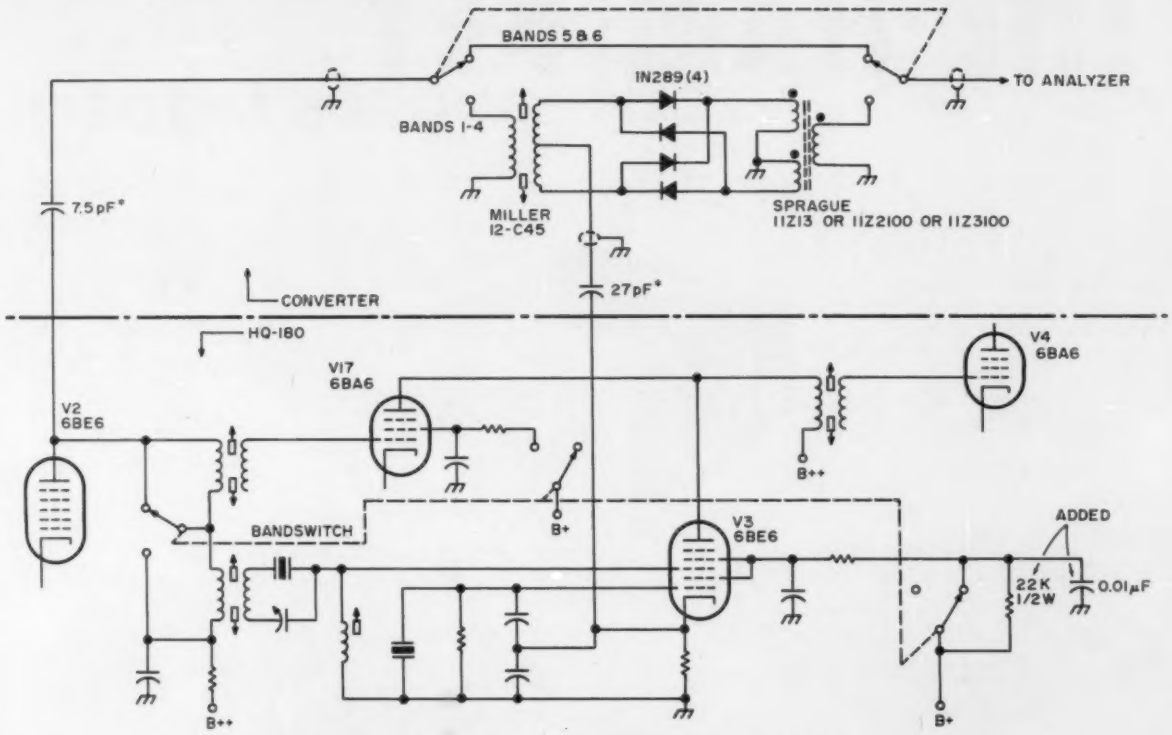

*Fig. 3. *Install in receiver as close as possible to pickup point.*

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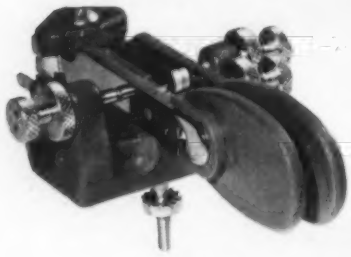

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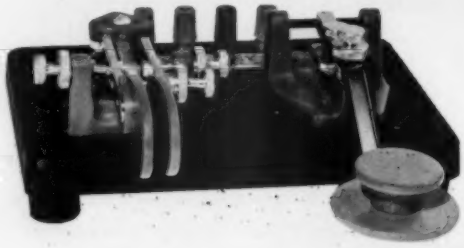

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DXing with a Weather Map

-- a new 6m DX technique

Since I read all the propagation reports, I decided it was about time to chime in my two cents worth (15 years worth to be more precise). This is an article on the propagation of radio waves – 6 meter radio waves to be exact. As anyone can tell by my past VHF articles, I am addicted to that portion of our bands.

There is one BIG factor in 6 meter propagation many seem to overlook except for some of its groundwave effects – WEATHER!

Nearly all large newspapers cover the only information you really need. I'm referring to the little map that shows all the little high and low pressure cells floating around and the fronts are shown, too. If you can copy the weather satellites, all the better, but at least make sure what time your newspaper map was drawn up for, as there is a lag from weather bureau to news desk, to press, to you. You will need to adjust for that difference, as weather is everchanging.

The trick for single hop DX (I know, E layer and all that jazz be darned) for us has been to find a low pressure (storm type – mucho electrons excited) cell about halfway between us and where we want to go. If you can draw a straight line (allowing for the Earth's curvature) from you to the desired destination, and hit the "edge" (not middle) of one of these cells, you are home like a bandit. More than 50% of my DX work has occurred on a *dead* band! There is much pleasure in this, too, until everybody else wakes up, since your contacts can be many minutes long and quite rewarding – not 5-9-9 contest style.

In order to explain the edge of the storm cell theory, and since no one (including me) seems to ever remember it by the direction of wind circulation around the cell, let's take a storm cell (low) to your West. Aim to go "under" it as it appears on the map. Example: I am in Indiana, target is California, and cell is right on a line from Indianapolis to San Francisco and about halfway between. Aim on the Los Angeles side, not the upper or Sacramento side. Reverse this and go "over" storms to your East, left of storms to your North, and right of storms to your South. All this is with reference to a map laid before you with the North direction to the top, which is the normal.

I neither know precisely why this works, nor why the other side of the low cell doesn't work – nor does either side of a high pressure cell regardless of its size or intensity! I assume it has more to do with the electrical charge and intensity than the barometric pressure itself.

I sincerely would appreciate hearing any and all reports of success or failure using this method; as for me it has proven almost 90% effective. Give it a chance to work before you panic and scream. Also, anyone who believes he can explain why it works is welcome to do so. I do things because they work and then figure out why. Just a simple explanation will do. Random chance for such an occurrence is extremely small compared to our success.

Thank you all for the SASEs on past articles – it does assure you of a speedier reply – usually one day turn around unless you totally stump me, which has happened. There were over 240 letters on the article on strobing displays, on updating counters in general and specifically the K2OAW model I started with. Forgive me please the "form" letter replies, but they let me answer all but one of them the same day.

Good DX, and when the low pressure cell gets very close to you with its inherent lightning – give it up for awhile or your next record mileage may be a QSL card from the heavens above! ■

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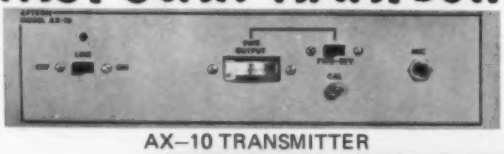

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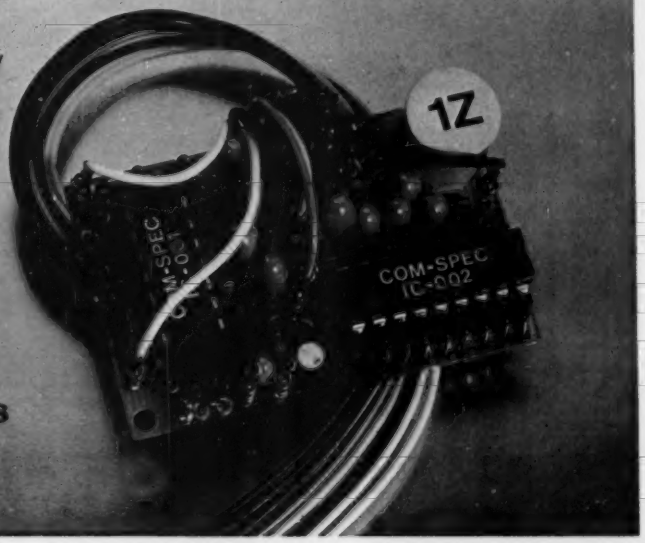

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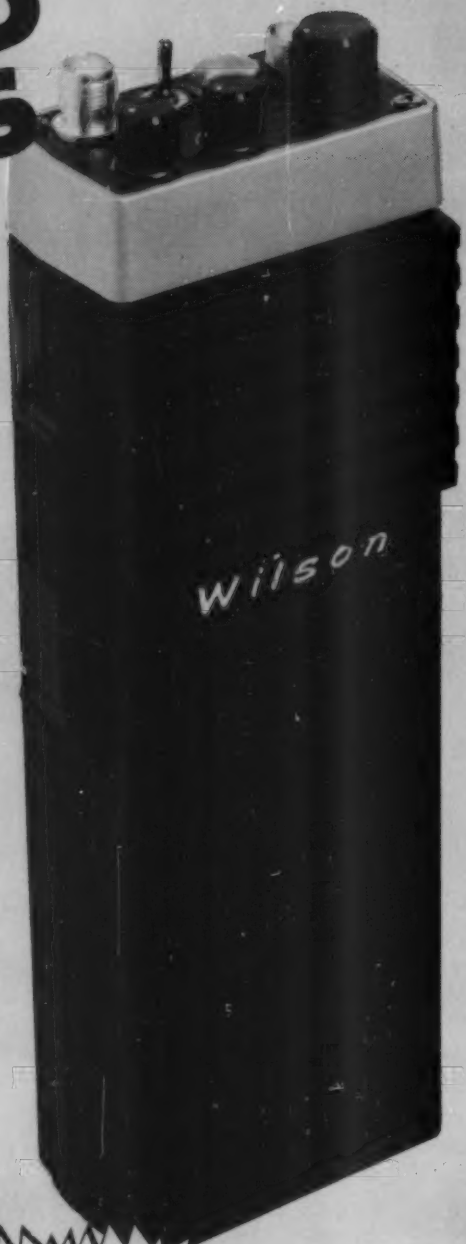

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Social Events

DALLAS TX
NOV 5-7

The First Southwest Vintage Radio & Phonograph Convention will be sponsored by the Southwest Vintage Radio & Phonograph Society on the 5th, 6th and 7th of November at the Ramada Inn-Dallas East in Dallas, Texas. Planned activities include forums on collecting of antique and vintage radios, restoration of antique radios, classic radios (McMurdo-Silver/Scott), antique phonographs, and general Q&A. The usual banquet, swap sessions, and an auction will also be held. Of special interest will be a contest of various equipment submitted by convention registrants. Three prizes will be awarded in each division. In addition a "Best-of-Show" award will also be made. For more information and a pre-registration packet, please contact Convention SVRPS, PO Box 19406, Dallas TX 75219.

McAFEE NJ
NOV 13-14

The 1976 Hudson Division Convention will be held November 13-14, 1976 at the Great Gorge Resort Hotel in McAfee, New Jersey. There will be ARRL and FCC forums, large indoor exhibit area with 40 booths, giant outdoor flea market, super raffle, free gifts, special features, indoor swimming, game room, and much more. Registration: advance $3, at door $4. For hotel registration: Al Piddington WA2FAK, 4 Acorn Drive, East Northport NY 11731.

LIVINGSTON NJ
DEC 3

The Livingston Amateur Radio Club will hold its second annual electronic flea market on Friday, December 3, at 7:30 pm at the Livingston Memorial Recreation Building. For further info, contact Jeff Gehl WN2AXL, (201)-267-0280.

BROOKLYN NY
DEC 19

The Kings County Repeater Association will hold an indoor flea market on Sunday, December 19, 1976, from 9 am to 4 pm. Located at 910 Union Street, Brooklyn NY (at Grand Army Plaza). Sellers $3.00, buyers $1, children free. Refreshments available. Talk-in on 146.43 and 146.52.

DAVENPORT IA
FEB 27

The annual Davenport Radio Amateur Club Hamfest will be held Sunday, February 27, 1977 at the Masonic Temple in Davenport, Iowa. Admission is $1.50 advance — $2.00 at the door. Talk-in on 28/88 and 52. Refreshments and tables are available. For info and tickets send SASE to Dick Lane WA@GXC, 116 Park Avenue, So. Eldridge IA 52748.

FORT WALTON BEACH FL
MAR 20

The Fort Walton Beach Swapfest will be held Sunday, March 20, 1977. For further information contact Playground Amateur Radio Club, PO Box 873, Fort Walton Beach FL 32548.

I/O EDITORIAL

from page 71

would go almost mad to be around that much in goodies. 8080s? Oh yes, here is a carton of several thousand. Memory chips? They're over there in

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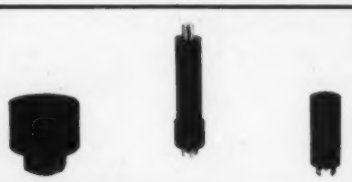

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that stack of cartons. One of Godbout's most popular items is a 4K memory board, and we got a promise from Reo Pratt for an article on it for *Kilobyte*.

Bill and Reo drove us over to see George Morrow ... an incredible genius. He was hard at work on a whole bunch of projects ... the Godbout PACE computer system (working just fine and ready for production) ... a front panel for the Altair and Imsai with a fantastic operating system built into it ... and a bunch of other projects. George promised articles on the PACE, on his front panel, on stopping a computer, on his secret prototyping system. Now if we can only get him to stop building long enough to write!

Bill, Reo, George, Sherry and I got in Bill's plane and flew out to Santa Rosa for dinner. I spent most of the time rag chewing on 2m with my HT. Bill had bought the plane up here in New Hampshire last spring and taken it back to Oakland. They originally tried to get me to buy the plane (it was a very good deal), but I am too careless a pilot and if I started flying again I'd kill myself for sure. I sold my last plane when I needed money to put out the first issue of *73* ... in 1960. I had a lot of adventures while I had my plane.

Down in L.A. we visited Dennis Brown of Wave Mate. This is the wire wrapped computer ... and it is a bit more expensive than most of the others so business wasn't quite as hectic as for some. I suspect that once Dennis gets his ideas across there will be a lot more enthusiasm for both wire wrapping and for the Wave Mate. There will be some articles by him on both wire wrapping and on the design concepts at the Wave Mate. There may be a Wave Mate in your future ... watch out.

John French of The Computer Mart in Orange has been doing fantastically with high Lear-Siegler terminals and was putting the finishing touches on a 16-bit computer system which will be introduced shortly. Naturally, we got a promise of an article on it for *Kilobyte*. Just what the computer hobbyist reaction to the coming 16-bit systems will be is quite a question. They probably don't need the speed and computing ability of such a machine, but I'll bet they will go for it anyway.

My next stop was in Salt Lake to see how Sphere was doing. They've been having quite a bit of trouble ... in part due to a credibility gap on promised software ... partly due to parts problems ... documentation delays ... etc. The new president, with whom I had an appointment, was not available. Doug Hancy gave us a tour of the building and promised that a system for our lab would be shipped immediately.

Next month: on to Albuquerque and the Mighty MITS Machine!

NEW AND BETTER CHIPS

There is a lot of excitement over the Zilog Z-80 microprocessor chip. It is an advanced version of the Intel 8080 ... much more flexible. I view this with very mixed emotions ... on the one side I'm enthused about being able to put aside my nice $650 CPU with the 8080 and put in a new Z-80 CPU which will probably run another $650 or so. I'll overlook the fact that I've barely been able to get the old computer system working long enough to do much with it ... certainly not long enough to develop a large number of programs.

I suspect that the Z-80 means that much of the small computer industry is going back to square one as far as programming is concerned. While it is nice that the Z-80 will work with the 8080 programs (not completely, I understand ... but for the most part), I also understand that no serious programmer would ever put up with using 8080 programs on the Z-80 ... it isn't efficient. No, they'll go back and write new compilers for BASIC ... and that might take as long as last time.

The Altair 8800 first came out in January, 1975. Their BASIC compiler was debugged and out about a year later ... and we are still waiting for much in the way of application programs for the system. The fact is that it takes a long time to write programs. The 6800 came out along in late 1975 and, as far as I know, there

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is not yet a BASIC compiler available for it that is full sized. There are a couple for Tiny BASIC or Micro-BASIC . . . and others are to be ready soon. There is less than that for the other systems which have come later.

So here we go back again! And when the Z-80 comes along next January, will we do another memory dump and start still again? Or will it be the Intel 8888 that gets everyone all excited next year . . . or the year after? There is much to be said for sticking with the good old 8080 and working out programs so that we can use it.

Space is available for conflicting viewpoints, as they say on TV.

NO WAY TO TURN

The old "tube" hams are getting very nervous. The rash of articles in *73* bringing us all up to speed on modern technology . . . the large scale integrated circuit and its main result, the microprocessor, has sent some into shock . . . others to the midnight oil to try and catch up. The "I just don't want to know about it" crowd (3999 kHz, e.g.) thought they had an out . . . until their last inner sanctum of protection against the onrush of progress dumped on them with a series of articles on . . . microprocessors!

Other than canceling subscriptions to everything but *CQ*, there *is* no way out. The initial reaction was of utter panic . . . computers are *not* any part of amateur radio and they will *have* to go away . . . right?

Speaking of *CQ* . . . has anyone seen it on the newsstands anywhere? It used to be sold by newsstands, but I haven't seen it in a couple of years anywhere. I think *73* is the *only* ham magazine being sold on newsstands these days.

If you happen to run into old-timers suffering from future shock and who want to get into at least a speaking acquaintance with microcomputers, the new *73* book "Hobby Computers Are Here!" is the only book out which will help make the transition relatively painless. $4.95 from the *73* Radio Bookshop. Engineers may get some value out of the *HR* series of reprints from a scientific journal on microprocessors. So far, about 90%+ of the original material on the subject has been published in *73* . . . shades of the old FM days seven years ago.

WILL KILOBYTE ROB I/O?

It appears as if *Kilobyte* is going to be a lot more software- and systems-oriented than the I/O section of *73*, so I expect that I/O will be carrying on. We've covered a lot of the computer fundamentals in *73* already, but we still have more to go. And we surely are going to have a lot of ham applications of computers in *73*. Hopefully, once the basics of the field are published in *73*, we won't have to go back over them.

Authors with ham applications for computers should run, not walk, to their typewriters.

ATLANTA 1977

The Atlanta Hamfest is being expanded this coming year to include a Computerfest. The Hamfest will be centered on Saturday, June 18th and the Computerfest on Sunday, June 19th. This will be the big hamfest and computerfest for the southeast for 1977, so plan your vacations accordingly.

Atlanta is a great city for something like this since there is so much entertainment for the family . . . they don't have to stand around whining while you take a close look at the latest equipment. Stone Mountain will keep them occupied for at least a day . . . they'll enjoy the excitement of a ride on the railroad around the mountain. Then there is Underground Atlanta . . . complete with a computer which will print out your portrait on a Teletype machine! Atlanta has a lot to offer.

In addition to about 80 exhibits by ham dealers and manufacturers, there are expected to be about 50 or so by computer firms . . . and perhaps the biggest flea market yet for both ham gear and computer equipment. You'd better make your reservations early so you'll be right in the middle of the action.

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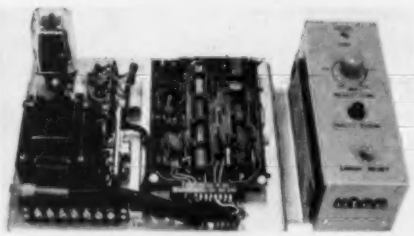

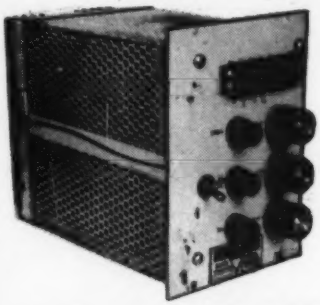

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EDITORIAL BY WAYNE GREEN

from page 4

for protecting our low bands (we've already lost almost all of our VHF and UHF bands) is to get one or more teams of top-notch ham ambassadors out there to sell amateur radio to the smaller countries.

The obvious way to do this is to get the ARRL directors off their duffs, and have them reach into the League pocket and get people like Bill Eitel or Lloyd and Iris Colvin out there visiting these important countries. The League has over $1,000,000 just sitting around in cash and securities, which should be out there working for the hobby. Perhaps it is time for the members to insist that the Miser of Newington stop hoarding money for some rainy day and check the storm clouds which are brewing.

Several years ago the board of directors set aside a $100,000 slush fund for "protecting our frequencies." Money gets spent out of this fund every year, but so far no accounting of these expenditures has ever been made to the members. The hundred thou would probably do the job we need done — if it were used honestly.

So what can *you*, the ARRL member, do? You can pin down any ARRL director who shows his face at your club or at a hamfest and insist on getting an accounting of *your* money. Insist that he tell you exactly how that hundred thou has been used in the past, or vote him out of office. Don't blame the officials too much ... the money was there and they thought there would be no accounting to the members for it, so they did just what you might expect.

If your director levels with you about the corruption, and promises not only to end it but to see that something is done immediately in the way of serious WARC (ITU) preparation, then perhaps you can forgive him for being part of the coverup and elect him again.

Lloyd and Iris Colvin would be ideal ham ambassadors ... they know the values of amateur radio to small countries ... they've been just about everywhere in the world, and they are about as nice people as you will ever meet. Lloyd was being considered seriously for president of the League a few years back, and I think that one of the most serious mistakes the directors have made in recent times was in giving in to Huntoon and electing his crony Daniels.

We have but two years left to beat the bushes for votes among the small countries ... are you going to let this conference go the way ARRL did the last one, when we lost 64,492 MHz out of our UHF allocated 64,495 MHz? That's right ... we went into the last conference at the ITU and lost 99.995% of our UHF satellite frequencies. If you don't put the pressure on your director and do it right now, you could be doing great harm to one of the most valuable human resources our country — or any other country — has ... radio amateurs. Elect directors who will break the cobwebs on the Newington purse and get us all out of this fix. Let's put some of that million bucks to work while there is still time.

IT MAY BE A FIGHT

Since Baldwin (he's running things now) permitted the board of directors of the ARRL Foundation to resign in protest rather than permit that organization to try and help with the WARC effort, it seems more than likely that he will do everything he can to prevent the directors from pursuing the same goals. I'll bet you haven't heard about *that* fiasco from your director either ... most of them are

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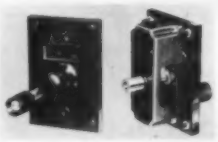

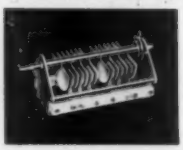

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3014	1.85	3029/3905-1	5.05
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GROUNDED-GRID FILAMENT CHOKES
B&W FC15A dual winding 15 A $24.50
B&W FC30A twin dual winding 30 A 29.00
R-F PLATE CHOKES
B&W 800 90 mH 2.5 kV 500 mA $8.75
National R175A 145 mH 3 kV 800 mA 10.60

IRON POWDER TOROIDAL CORES

Size	Price	Size	Price
T200-2	$1.60	T50-6	$ .30
T130-2	1.15	T50-10	.30
T106-2	.75	T50-12	.30
T106-3	.75	T44-2	.25
T94-2	.50	T37-2	.25
T94-6	.50	T37-6	.25
T80-2	.40	T37-10	.25
T80-3	.40	T37-12	.25
T68-2	.35	T25-2	.20
T68-3	.35	T25-12	.20
T68-6	.35	T12-2	.15
T50-2	.30	T12-2	.15
T50-3	.30		

Ferrite Toroidal Cores

Size	Price
FT-50-61	.35
FT-50-72	.35
FT-82-61	.40

Ferrite Shielding Beads

Size	Price
FB-73-101	$1.00 Doz.
FB-43-101	1.00 Doz.
FB-73-801	1.50 Doz.
FB-43-801	1.50 Doz.

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sitting on top of that bomb and don't know what to do about it.

Being an ARRL director may have prestige, but it offers little fun. Most of them are afraid to talk with other directors, for they never know which one will report it to Baldwin and make them suddenly "the enemy." Directors are supposed to show up at one or two meetings a year, vote unanimously yes or no, and not ask too many questions. Other than that, they have to go to club meetings and hamfests in their area and pass along the "word" from HQ. Members keep this system going by re-electing directors for years.

Perhaps it is unreasonable of me to measure the interest of a director by whether he gets *73* or not . . . but how can anyone really be in touch with things if he doesn't read *73*? I just checked, and seven of the 15 directors are *not* subscribing. If you run across Haller, Egbert, Zak, Sullivan, Thurston, Gmelin or Price, you might mention the terrible things you saw in *73* about them . . . drive them crazy.

Half of the directors are up for grabs every year, so you *can* change things if you'll take an interest. Get someone you can trust to run for the job and get him elected. There were a lot of posters at the Chicago hamfest for Don Miller W9NTP to replace Haller . . . that would be a great change. Don is the SSTV pioneer, not the DXpeditioner who almost ruined DXing. In most cases you can't go too far wrong by getting someone new.

INFLATION AND SUCH

Those few really brainwashed ARRLers who fell for the "more is less" baloney last year and believed that a bigger *QST* would cost less are having to face up to the facts of life . . . which are just as I predicted in *73*. *QST*'s costs have gone up substantially . . . and so have the costs of all the other ham magazines . . . the result of the new size. Well, the new size is here and it isn't going back again. Most of the magazines have had to change printers in order to match the new size to bigger presses.

QST has announced their new advertising rates . . . up to $912 for a page now. *73*'s rates are $1095 for one page. The latest rate we have for *HR* is $695, and *CQ* is $575. Since advertising rates are based largely on circulation, this may tell you something.

Apparently the recent rise in *73* readership has some people worried. ARRL is running a poll of their members to find out what it is about *QST* that they don't like. If you get one, please don't forget to tell 'em how much you really enjoy and look forward to the SCM reports and contest results . . . okay?

The 1976 cover price for the ham magazines has been $1 for all but *73* . . . which at $1.50 has been the best selling by far on newsstands and over radio store counters. We understand *QST* is increasing to $1.50 in January . . . no word on *HR* or *CQ*. *73* will go up to $2 in January and the yearly subscription rate will go up to $12.50, with $25 the price for three years. You say you forgot to send in the $17.76? That's the way it goes.

LIFE ON TIME PAYMENTS

A life subscription costs $150 these days. That's a little heavy for most people, so we'll go along with a five payment system . . . $30 per payment for five months. The life subscription is a good deal . . . not a few *73* subscribers bought in years ago and have been sailing free for a long time. You know that inflation is not going to stop . . . that paper and postage are going to keep going up . . . so grab this bargain while you can. Just send $30 and a note that you want to be a lifer.

RECENT HAMFESTS

Let's see . . . somehow we managed to survive an ARRL convention in Philadelphia . . . right in the middle of the American Legionnaires who were dropping like flies. Our *73* booth was constantly surrounded by them all weekend. Few hams had to worry about getting sick, since they stayed away from the convention by the tens of thousands.

The Boston convention pulled about what I expected for a downtown Boston affair . . . not very much. I was on the speaking program

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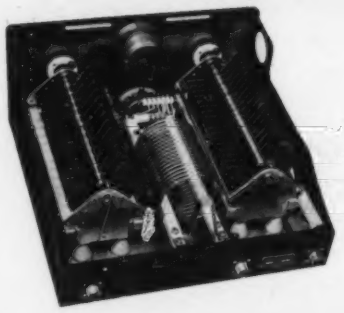

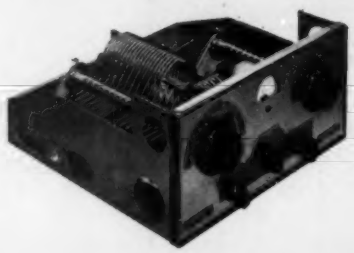

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Serious about antennas? Then you will want to know about the new Millen impedance bridge. Write for details.

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MANUFACTURING COMPANY, INC.

. . . 5:00 am on Sunday morning, I think it was. Well, shucks, that's better than not being able to speak . . . right? I wasn't all that interesting, but if you would like to hear me you can get a tape of the debacle from *73* for $4. An hour, about.

One exhibitor made the mistake of parking his van on a Boston street and had the roof almost pulled out, along with the CB and ham rigs attached to it.

The most popular exhibits, again, were the computer-oriented ones by The Computer Store, Computer Mart, and American Used Computers. I'd sure like to see more combination hamfests/computerfests . . . perhaps with the hamfest part centered on Saturday and the computerfest on Sunday . . . I think it would be good for both groups . . . as well as the about 33% overlap between them.

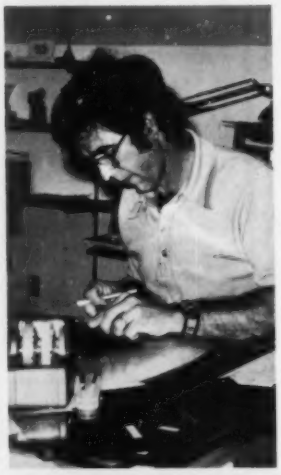
One week after the New England ARRL convention came Expo 76 at Chicago. This affair is improving every year. There is talk of moving it to a hotel near O'Hare next year. Expo had me on the program . . . in prime time, by golly. I didn't have that much different to say from Boston, so there's no good reason to make tapes available of this. I talked a lot about *Kilobyte*, as a matter of fact . . . and we took a lot of *Kilobyte* subscriptions at our booth. I guess just about everyone is getting *73* by now.

While I enjoy getting out and saying hello to a thousand or so readers, I wonder whether I'm doing better that way than staying at home and answering the mail . . . and there is an awful lot piling up as a result of my traveling around. I dunno.

SUPPORTING CAST: II

As promised, here is the second installment of portraits from the *73* gallery.

Chris Dillon is seen here working on file records of orders for books, tapes, and back issues sent out. Every now and then something gets screwed up in shipment and she has to be able to go back and find what was shipped where and when.



Noel Ray Self is working on negatives for 73 Magazine *and for the latest* 73 *books. Photographs have to be made separately and glued onto the negative of the type and drawings . . . a job requiring great precision. Negatives are never perfect, so Ray has to find all pin holes and go over them with paint to opaque them. Where ads are placed on pages, negatives have to be spliced together. Duplicates are then made on single sheets of film. Ray does the splicing . . . also adding the page numbers at the bottom . . . etc.*

Continued on page 208

2 METER CRYSTALS

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6.82R
6.25T
6.85R
6.28T
6.88R
6.31T
6.91R
6.34T
6.94R
6.37T
6.97R
6.40T
6.46T
6.46R
6.52T
6.52R
6.55T
6.55R
6.58T
6.58R
6.94T
7.60T
7.00R
7.63T
7.03R
7.66T
7.06R
7.69T
7.09R
7.72T
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7.75T
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Sonar 1802-3-4, 3601
Standard 146/826
Standard Horizon
Swan FM 2X
Tempo FMH
Trio/Kenwood TR2200
Trio/Kenwood TR7200

Note: If you do not know type of radio, or if your radio is not listed, give fundamental frequency, formula and loading capacitance.

CRYSTALS FOR THE IC-230 SPLITS IN STOCK: 13.851111 MHz; 13.884444 MHz; 13.917778 MHz; HEATHKIT HW2021 600 KHz. OFFSET 11.3 MHz; $6.50 ea.

MASTER GAINER

MODEL GG-144A — Deluxe, Two-Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a ½ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator: ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section. Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. SO-239 coax connector $62.95

GG-144A

STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—50 watts FM

MODEL BBLT-144 47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17 MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $29.75

MODEL BBL-144 47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17 MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $26.95

BBLT-144 BBL-144

THF

VHF/UHF ANTENNA—TRUNK LIP MOUNT

MODEL THF Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17 RG-58-U and PL-259. $15.95

SUPER GAIN MOBILES

Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—140-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

MODEL CG-144 Same characteristics as CGT-144 supplied with ¾"-24 base to fit all mobile ball mounts—Length is 93". Mount and cable not included. $20.75

CG-144

HUSTLER "BUCK-BUSTER"

MODEL BF-2 91" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ¾"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included) $12.75

BF-2

MODEL TLM Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58 U cable and connectors attached. $14.85

TLM

DELUXE MOBILE MOUNTS

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MODEL TLM Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached $12.05

MODEL GCM-1 Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. $7.50

GCM-1

HUSTLER

UHT-1

VHF/UHF ANTENNA—ROOF MOUNT

MODEL UHT-1 Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ¾" hole. Includes 15' RG-58-U $10.15

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STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of publication, 73 Magazine. 2. Date of filing, 15 Sept 1976. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $10.00. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor, and managing editor. Publisher (Name and Address) Wayne Green, Peterborough, N.H. 03458. Editor (Name and Address) Wayne Green, Peterborough, N.H. 03458. Managing Editor (Name and Address) Jack Burnett, Peterborough, N.H. 03458. 7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) Name, 73 Inc., Peterborough, N.H. 03458. Wayne Green, Peterborough, N.H. 03458. 8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM) The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. copies printed (Net Press Run) (X) 96,584 (Y) 98,492. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales, none. 2. Mail subscriptions (X) 90,721 (Y) 92,514. C. Total paid circulation (Sum of 1081 and 1082) (X) 90,721 (Y) 92,514. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 1,680 (Y) 1,713. E. Total distribution (Sum of C and D) (X) 92,401 (Y) 94,227. F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 3,806 (Y) 3,881. 2. Returns from news agents (X) 377 (Y) 384. G. Total (Sum of E, F1 and 2 – should equal net press run shown in A) (X) 96,584 (Y) 98,492. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. Biff Mahoney, Business Manager.

Tracking the Hamburglar

STOLEN: Drake TR-22 2 meter transceiver, s/n 640139, beige Trimline TT Handset, magnet mount quarter wave antennae. Crystals for 52/52, 16/76, 37/97, 87/27, 63/03, 34/94. Stolen from Rick Simpson KØUZP, 2723 Rigel Drive, Colorado Springs CO 80906, 303-471-2059.

TAKEN: Wilson T1402 S/M 2 meter handie-talkie, s/n OR6427. Crystals for 52/52, 22/82, 25/85, 16/76, 34/94, 69/09. Stolen from James Hettle, PSC #1, PO Box 2493, Peterson AFB CO 80914.

RIFLED: Heathkit HW-202 with installed Tone Burst Encoder, TTPAD, six (6) sets xtals 34/94, 94/ , 25/85, 115/715, 28/88, 16/76 (switch indicates 04/64 but xtals are

NOTICE

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16/76). My san 125-32-5960 on various parts internally including underside of trans and rec boards. Also stolen: Courier Comet 23 CB, s/n 12300643. Stolen from my parked auto in Garden City NY on August 30, 1976. If found, please contact heart-broken owner, David K. Gordon WB2YUJ, 155 Nimbus Road, Holbrook, NY 11741.

ROBBED: Yaesu FR-101SD1G HF digital receiver, s/n 6C31339. Yaesu FL101 HF digital transmitter, s/n GE306276. Stolen from Associated Electronic Service, 404 Arrawana, Colorado Springs CO 80909.

RIPPED OFF: Kyokuto FM-144 2m transceiver, s/n 6215. Stolen from vehicle at Los Angeles Coliseum on July 24, 1976. Contact Abel J. Tapia WA6FSZ, PO Box 414, Montclair CA 91763.

RUSTLED: Drake MN-2000 matching network, s/n 6485. Heath SB-650 frequency counter. Stolen on August 29, 1976 from auto in Rockland County. Please contact Cliff Cooley, Jr. WN2GHL, 4 Camp Hill Road, Pomona NY 10970.

HIJACKED: Icom 230 2 meter radio, s/n 240-2915, forcibly removed from vehicle in Fort Wayne, Indiana on September 4, 1976. Report filed with Fort Wayne police. Kenneth C. DeGroff WB9OCW, 62322 Oak Road, South Bend, Indiana 46614

FCC

FCC ANNOUNCES CHANGE IN ISSUANCE OF NOVICE CLASS AMATEUR RADIO CALLSIGNS

As part of its continuing effort to provide the public with rapid and effective service, the Commission will shortly cease issuing distinctive callsigns to Novice class amateur radio stations.

Presently, Novice class stations in the continental United States are issued callsigns prefixed by the letters "WN" to facilitate their identification as Novice stations. Novice stations outside the continental United States are also assigned distinctive callsigns. This practice has proved to be unsatisfactory, however. It has caused several difficulties in the processing of amateur applications, not the least of which are the issuance of the same callsign to two different stations and the issuance of callsigns in callsign blocks, such as "WC," which are not available for general amateur use.

Accordingly, beginning October 1, 1976, each Novice callsign was assigned in accordance with the following:

Present Prefix	*New Prefix*
WNØ	WBØ*
WN1	WB1
WN2	WD2
WN3	WB3
WN4	WD4
WN5	WB5*
WN6	WD6
WN7	WB7
WN8	WD8
WN9	WB9*
WH6	KH6
WL7	KL7
WP4	KP4
WP6	KP6
WG6	KG6
WS4	KS4
WS6	KS6
WV4	KV4
WW6	KW6
WJ6	KJ6

*Callsigns in these areas are presently nearing the end of the WB series. After "WB" prefixes are depleted, "WD" callsigns will be issued.

All amateur Novices with license expiration dates of October 1, 1976 or later will be issued new Novice licenses in the near future. Such new licenses will be identical to the licenses superseded, except that they will have printed on them the callsigns the Novice licensees would have been assigned under the old callsign assignment system upon obtaining higher class operating privileges. The new callsign must be used by the Novice licensee as his callsign.

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First grade epoxy glass 1/16" cut to your size for only $0.02 per square inch, single sided. Double sided $0.035 per square inch.

* PC BOARD PROJECT KIT
This kit includes an assortment of single and double sided PC stock in useable sizes, plus one pint of immersion tin plate solution and five pounds of etch. Instr. included. $14.95 ea.

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For professional PC boards you must tin plate them. Enhances solderability and appearance. 1 qt. will plate dozens of average size PC boards. No fuss, no muss – dunk 'em and out come bright shiny easy to solder PC boards. Instr. incl. $8.95/qt.

* COPPER ETCH CRYSTALS
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* VIATRON SYSTEM 21
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(Data and code sheets incl.)

* UART
COM2502/2017 40 pin DIP UNTESTED- $3.95. But the ones we've checked work fine at 4.5 volts instead of 5.0.

* LINEAR

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DATEL IC8B	DAC	9.95
LM309K	TO-3	1.49
NE555	DIP	.50
LM5000 5A	Reg	4.95

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TIS98	NPN	.59
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Instruction Book 1.00

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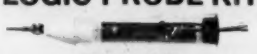

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Type	Description	Price
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11C06DC	UHF Prescaler 750 MHz D Type Flip/Flop	$12.30
11C24DC	Dual TTL VCM	$2.60
11C44DC	Phase Freq. Detector	$2.60
11C58DC	ECL VCM	$4.53
11C70DC	600 MHz Flip/Flop With Reset	$12.30
11C83DC	1 GHZ 248/256 Prescaler	$29.90
11C90DC	650 MHz ECL/TTL Prescaler	$16.00
11C90DM	650 MHz ECL/TTL Prescaler	$24.60
11C91DC	650 MHz ECL/TTL Prescaler	$16.00
11C91DM	650 MHz ECL/TTL Prescaler	$24.60
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95H91DC	250 MHz Prescaler	$9.50
95H91DM	250 MHz Prescaler	$16.50

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2N4072	$1.50	2N6083	$12.95
2N4427	$1.20	2N6084	$13.75
2N5179	$.68	2N6166	$85.00
2N5589	$4.60	MRF511	$8.60
2N5590	$6.30	MMCM918	$2.50
2N5591	$10.35	MMT2857	$2.50
2N5637	$20.70		

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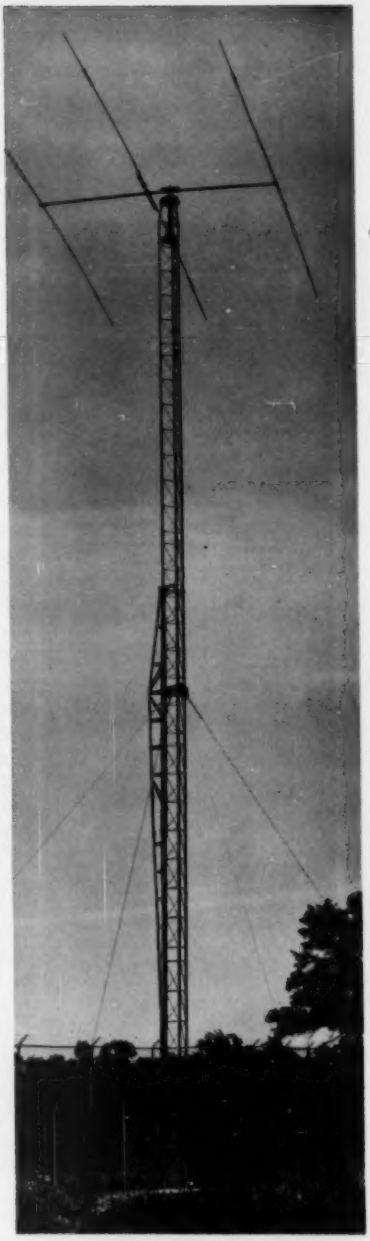

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307H op amp	0.35
308M op amp	1.00
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309K +5V reg.	1.25
311M comparator	1.00
311H comparator	1.00
316H hi ℅ op amp	2.50
318H fast op amp	1.00
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339D quad compar.	1.50
340/+5K reg.	1.25
340/+5T reg.	1.75
340/+6T reg.	1.75
340/+8K reg.	1.75
340/+8T reg.	1.75
340/+12T reg.	1.75
340/+15K reg.	1.85
340/+15T reg.	1.75
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733H video amp	1.50
741M op amp	0.30
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748H,M op amp	0.35
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1496D bal mod.	1.25
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3065D TV sound	0.75
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4194D track reg.	1.50
4194TK pwr 4194D	2.50
4195TK +15V reg.	2.25
4250H program op	1.00
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4741H dual 741	0.50
5556M see 1556M	
5558M dual 741 op	0.55
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4000	$0.25
4001	0.25
4002	0.25
4006	1.50
4007	0.25
4008	1.10
4009	0.45
4010	0.45
4011	0.25
4012	0.25
4013	0.50
4016	0.50
4015	1.10
4016	0.55
4017	1.25
4018	1.50
4019	0.55
4020	1.50
4021	1.45
4022	1.20
4023	0.25
4024	0.95
4025	0.25
4026	1.50
4027	0.65
4028	1.00
4029	1.35
4030	0.45
4033	1.50
4035	1.25
4037	0.50
4040	1.50
4041	0.85
4042	0.85
4043	0.60
4044	0.60
4047	1.50
4049	0.50
4050	0.50
4116	0.60

TTL

7400	$0.18
7401	0.18
7402	0.18
7403	0.18
7404	0.20
7405	0.20
7406	0.36
7407	0.36
7408	0.23
7409	0.23
7410	0.18
7411	0.23
7413	0.71
7414	0.70
7416	0.36
7417	0.36
7420	0.18
7422	0.23
7425	0.36
7426	0.25
7427	0.26
7430	0.18
7432	0.27
7437	0.36
7438	0.36
7439	0.45
7440	0.18
7441	0.98
7442	0.80
7445	0.63
7446	1.34
7447	1.34
7448	1.34
7450	0.18
7451	0.18
7453	0.18
7454	0.18
7460	0.18
7461	0.18
7472	0.32
7473	0.36
7474	0.36
7475	0.80
7476	0.36
7483	0.89
7485	1.60
7486	0.36
7489	2.23
7490	0.80
7491	0.98
7492	0.98
7493	0.71
7495	0.98
7496	0.98
74100	1.34
74107	0.36
74121	0.45
74123	0.71
74125	0.71
74126	0.71
74143	5.00
74145	0.89
74150	1.07
74151	0.71
74153	0.80
74154	1.25
74155	0.71
74156	0.90
74157	0.71
74159	1.50
74160	0.89
74161	0.89
74162	0.89
74163	0.89
74164	1.34
74165	1.34
74173	1.34
74174	1.52
74175	1.34
74176	0.98
74177	0.98
74179	0.75
74180	0.98
74181	2.23
74182	0.80
74190	1.34
74191	1.34
74192	1.34
74193	1.34
74194	1.34
74195	0.71
74196	0.98
74197	0.98
74198	1.96
74199	1.96
74273	1.89
74365	0.63
74366	0.63
74367	0.63
74368	0.63
74390	1.50
74393	1.50

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74LS00	$0.36
74LS01	0.36
74LS02	0.36
74LS04	0.42
74LS08	0.38
74LS10	0.36
74LS11	0.38
74LS20	0.36
74LS21	0.38
74LS22	0.38
74LS27	0.38
74LS30	0.36
74LS32	0.38
74LS37	0.53
74LS38	0.53
74LS42	1.25
74LS74	0.56
74LS75	0.85
74LS109	0.60
74LS124	2.50
74LS125	0.75
74LS126	0.75
74LS132	1.50
74LS138	1.38
74LS139	1.38
74LS155	1.38
74LS157	1.25
74LS160	1.85
74LS161	1.85
74LS162	1.85
74LS163	1.85
74LS168	1.87
74LS169	1.87
74LS174	1.38
74LS175	1.35
74LS221	1.38
74LS240	1.88
74LS257	1.25
74LS258	1.38
74LS273	2.25
74LS283	1.20
74LS367	1.00
74LS368	1.00
74LS377	1.88
74LS378	1.38

TRANSISTORS

2N2221 NPN	7/$1.00
2N2222 NPN	5/$1.00
2N2907A PNP	5/$1.00
2N3055 NPN	$0.75
2N3904 NPN	7/$1.00
2N3906 PNP	6/$1.00
2N4249 PNP	5/$1.00
2N4250 PNP	5/$1.00
2N4400 NPN	5/$1.00
2N5135 NPN	10/$1.00
D41D1 PNP pwr	$1.50/pr

FIELD EFFECT TYPES

Dual N UHF/VHF	3/$1.00
N ch. RF amp	3/$1.00
Dual N lo noise	2/$1.00
N ch. gen purp	4/$1.00
6AK5 plug-in	$1.00

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2112 4 x 256 RAM	$2.95
5202 2K EROM	$9.95
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5610 open collec.	$2.95
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93410 Bipolar 256 bit RAM; fast	$2.00

INDUCTORS all values in microhenries

1.0	10/$1.00
1.2	10/$1.00
2.0	10/$1.00
2.7	10/$1.00
2.8	10/$1.00
6.8	10/$1.00
8.2	10/$1.00
12	10/$1.00
18	10/$1.00
22	10/$1.00
24	10/$1.00
27	10/$1.00
30	10/$1.00
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43	10/$1.00
47	10/$1.00
68	10/$1.00
82	10/$1.00
120	10/$1.00
680	10/$1.00

capacitors

All capacitors in uF, except when noted.

TANTALUMS

.47 @ 35V	4/$1.00
.82 @ 20V	4/$1.00
2.2 @ 20V	4/$1.00
2.7 @ 20V	4/$1.00
3.3 @ 15V	4/$1.00
4.7 @ 10V	4/$1.00
22 @ 10V	3/$1.00
33 @ 10V	3/$1.00
39 @ 10V	3/$1.00
47 @ 6V	3/$1.00

ELECTROLYTICS

10 @ 10V,PC type	5/$1.00
10 @ 250V, axial	3/$1.00
12 @ 250V, axial	3/$1.00
100 @ 10V, axial	5/$1.00
100 @ 35V, PC	4/$1.00
100 @ 50V, PC	4/$1.00
220 @ 25V, PC	4/$1.00
250 @ 25V, PC	4/$1.00
500 @ 15V	3/$1.00
1000 @ 25V	5/$1.95
2000 @ 30V, PC	1/$0.95
4000 @ 20V	1/$0.95
10000 @ 10V	1/$1.25

MYLARS

.0039, 50V	10/$1.00
.005, 25V	10/$1.00
.0068, 50V	10/$1.00
.01, 50V	10/$1.00
.02, 50V	10/$1.00
.033, 50V	10/$1.00
.047, 50V	10/$1.00
.068, 50V	10/$1.00
.1, 50V	10/$1.00
.22, 50V	10/$1.00
5.0, 100V, 10%	2/$1.50
10, 100V, 10%	1/$1.50

DISC CERAMICS

10 pF	10/$0.45
220 pF	10/$0.45
.001	10/$0.50
.0027	10/$0.50
.005	10/$0.50
.01	10/$0.50
.02	10/$0.75
.05	10/$1.00
.1	10/$1.25

HIGH VOLT ELECTROLYTICS

150 @ 350V	2/$1.35
200 @ 175V	2/$1.35
10 @ 400V with 4 @ 350V & 100 @ 350	2/$1.20

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150 pF	10/$1.00
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220 pF	10/$1.00
270 pF	10/$1.00
330 pF	10/$1.00
390 pF	10/$1.00
470 pF	10/$1.00
560 pF	10/$1.00
680 pF	10/$1.00
820 pF	10/$1.00
910 pF	10/$1.00
1000 pF	10/$1.00
1200 pF	10/$1.00
1500 pF	10/$1.00
1800 pF	10/$1.00
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2200 pF	10/$1.00
3300 pF	10/$1.00
3900 pF	10/$1.00

TRIMPOTS single turn PC mount; ½ watt.

250 ohms	5/$1.00
500 ohms	5/$1.00
1K	5/$1.00
2.5K	5/$1.00
3K	5/$1.00
10K	5/$1.00
50K	5/$1.00
1M	5/$1.00

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RESISTOR ASSORTMENT #1: 500 ¼ watt resistors with good mix of values $3.95

resistors

**QUARTER WATT, 10% (some 5%)
**AVAILABLE ONLY IN QUANTITIES:

100 OF ANY ONE VALUE	$1.70
1000 OF ANY ONE VALUE	$15.30

Choose from the following (in ohms)

1.0	27	470	8.2K	150K
1.2	30	510	9.1K	160K
1.5	33	560	10K	180K
1.8	36	620	11K	200K
2.2	39	680	12K	220K
2.4	43	750	13K	240K
2.7	47	820	15K	270K
3.0	51	910	16K	300K
3.3	56	1K	18K	330K
3.6	62	1.1K	20K	360K
3.9	68	1.2K	22K	390K
4.3	75	1.3K	24K	430K
4.7	82	1.5K	27K	470K
5.1	91	1.6K	30K	510K
5.6	100	1.8K	33K	560K
6.2	110	2.0K	36K	620K
6.8	120	2.2K	39K	680K
7.5	130	2.4K	43K	750K
8.2	150	2.7K	47K	820K
9.1	160	3.0K	51K	910K
10	180	3.3K	56K	1.0M
11	200	3.6K	62K	1.1M
12	220	3.9K	68K	1.2M
13	240	4.3K	75K	1.3M
15	270	4.7K	82K	1.5M
16	300	5.1K	91K	1.6M
18	330	5.6K	100K	1.8M
20	360	6.2K	110K	2.0M
22	390	6.8K	120K	2.2M
24	430	7.5K	130K	

sockets

LOW PROFILE SOCKETS
Soldertail, tin plated.

14 pin	10/$1.95
16 pin	10/$2.15
18 pin	10/$2.75
20 pin	10/$3.10
22 pin	10/$3.50
24 pin	10/$3.60
36 pin	10/$5.50
40 pin	10/$6.15

WIRE WRAP SOCKETS
3 level, gold plated.

14 pin	10/$3.70
16 pin	10/$3.85
18 pin	1/$0.75
24 pin	1/$1.00
28 pin	1/$1.25
36 pin	1/$1.35
40 pin	1/$1.75

STANDARD SOLDERTAIL SOCKETS
Gold or tin plated

14 pin	10/$3.70
16 pin	10/$3.85
24 pin	1/$0.75
28 pin	1/$0.75
36 pin	1/$1.00
40 pin	1/$1.25

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THANKS AGAIN
for another really wonderful year!

TI readers have always been good to us. This year... even more of you have become our friends and customers. Naturally, we're really grateful. You've even helped us combat our nation's unemployment problem... by making us expand our staff! The letters, jokes and comments you send with orders are always welcome, and fully enjoyed! We love the feelings we get from that personal communication of people to people. We're proud that you like us and our service, parts, and kits as well. You are people having a good time with your various projects and hobbies, and we are people having a good time making it economical and easy for you to obtain the parts you need to play.

We had alot to celebrate in 1976, and now alot to look forward to in 1977! Enjoy, Enjoy this Holiday Season!

From all of us, to all of you...

Dewey Fisher, Jean Marshall, Linda Barlow

Bob Brott

Bill

CAVE grafx™

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BOX 2355, OAKLAND AIRPORT, CA 94614

7400N TTL

SN7400N*	.18	SN7430N	.35	SN74154N*	1.00
SN7401N	.18	SN7432N	.22	SN74155N*	.99
SN7402N	.21	SN7437N	.45	SN74156N*	.99
SN7403N	.18	SN7438N	.39	SN74157N*	.99
SN7404N*	.18	SN7440N*	.32	SN74160N	1.25
SN7405N	.39	SN7441N*	.99	SN74161N	.99
SN7406N	.29	SN7442N*	.99	SN74162N*	.99
SN7407N	.29	SN7443N*	.92	SN74163N*	.99
SN7408N	.25	SN7447N*	5.00	SN74164N	1.10
SN7409N	.25	SN7448N	.99	SN74165N	1.10
SN7410N*	.18	SN74S74N	.99	SN74166N	1.25
SN7411N	.32	SN74S38N	.70	SN74167N	5.50
SN7412N	.33	SN7485N	.99	SN74170N	2.10
SN7413N	.45	SN7486N	.39	SN74173N	0.95
SN7414N	.79	SN7489N	3.50	SN74174N	1.99
SN7416N	.39	SN7490N	2.25	SN74175N	1.25
SN7417N	.33	SN7492N*	.45	SN74175N	.99
SN7420N	.21	SN7493N	.75	SN74176N	.99
SN7421N	.33	SN7495N	.49	SN74177N	.90
SN7422N*	.49	SN7496N*	.49	SN74180N	.99
SN7423N	.37	SN7494N	.79	SN74181N	2.49
SN7425N	.29	SN7495N	.79	SN74182N	.95
SN7426N	.39	SN74S86N	.99	SN74184N	1.99
SN7427N	.37	SN7497N*	4.00	SN74185N*	2.20
SN7428N	.47	SN74188N*	1.99	SN74186N*	5.00
SN7430N	.39	SN74107N	.59	SN74187N	6.00
SN7432N	.31	SN74121N*	.79	SN74188N	3.99
SN7437N	.37	SN74122N	.59	SN74189N	3.99
SN7438N	.37	SN74123N*	.79	SN74191N	1.25
SN7439N	.35	SN74125N	.69	SN74192N*	.89
SN7440N	.19	SN74126N	.69	SN74193N*	.89
SN7441N	.89	SN74132N	1.09	SN74194N	1.35
SN7442N	.59	SN74136N	.99	SN74195N	.75
SN7443N	.75	SN74141N	1.15	SN74196N	1.25
SN7444N	.75	SN74142N*	4.00	SN74197N	.75
SN7445N	.75	SN74143N*	4.99	SN74198N	1.75
SN7446N	.91	SN74144N*	4.99	SN74199N	1.75
SN7447N*	.89	SN74145N	1.15	SN74200N	5.50
SN7448N	.79	SN74147N	2.75	SN74279N*	.89
SN7450N	.25	SN74148N	2.49	SN74251N	1.79
SN7451N	.27	SN74150N	1.00	SN74284N	6.00
SN7453N	.27	SN74151N	.79	SN74285N	6.00
SN7454N	.20	SN74153N	.89	SN74367N	.75

MANY OTHERS AVAILABLE ON REQUEST
20% Discount for 100 Combined 7400's

CMOS

CD4000	.25	CD4035	1.85	74C04N	.75
CD4001	.25	CD4038	2.45	74C10N	.65
CD4002	.25	CD4040	1.90	74C30N	.69
CD4006	2.50	CD4042	1.90	74C32N	.85
CD4007	.25	CD4044	1.50	74C42N	2.15
CD4009	.59	CD4046	1.50	74C73N	1.50
CD4010	.59	CD4049	2.51	74C74	1.15
CD4011	.25	CD4047	2.75	74C86N	2.69
CD4012	.25	CD4049	.79	74C90N	2.25
CD4013	.47	CD4050	.79	74C107N	1.25
CD4016	.59	CD4051	2.95	74C151	2.99
CD4017	1.35	CD4052	2.95	74C154	4.69
CD4018	.69	CD4066	3.25	74C157	2.15
CD4023	1.49	CD4068	1.75	74C160	3.25
CD4022	1.25	CD4069	.45	74C161	3.25
CD4023	.25	CD4071	.45	74C163	3.00
CD4024	1.50	CD4081	.45	74C164	3.25
CD4025	.25	CD4511	2.50	74C173	2.69
CD4027	.69	CD4516	2.99	74C192	2.75
CD4069	1.65	CD4518B	3.99	74C195	2.75
CD4030	2.99	74C00N	.99	MC14049*	4.99
CD4030	.65	74C02N	.59	MC14010*	.99

LINEAR

LM300H	.80			LM1310N	2.95
LM301H	.35	LM370N	1.15	LM1351N	1.65
LM301CN	.35	LM373N	3.25	LM1414N	1.75
LM308H	.75	LM377N	4.00	LM1458C	.69
LM309H	1.00	LM380N	1.39	LM1488N	.95
LM309K	.95	LM380CN	1.09	LM1556V	1.85
LM307CN	.35	LM380SN	1.09	LM2111N	1.95
LM308H	1.00	LM380N	1.39	LM2901N	2.95
LM308CN	1.00	LM380CN	1.05	LM3065N	.69
LM309H	1.10	LM381N	1.79	LM3900N	.55
LM309K	.99	LM382N	1.79	LM3905N	.60
LM310CN	1.15	MC601K	8.00	LM3909*	1.25
LM311H	.99	MC1496N	1.00	LM3909N	1.85
LM311N	.90	NE531H	3.00	MC5558V	1.00
LM312CN	1.69	NE536T	6.00	LM7525N	.99
LM318N	1.39	NE540L	6.00	LM7539N	1.35
LM320K-5	1.39	NE555N	.79	8038*	4.95
LM320K-5.2	1.39	NE556N*	.45	LM7549D	.49
LM320K-12	1.35	NE5009*	5.00	75451CN	.39
LM320K-15	1.39	NE5010*	5.00	75452CN	.39
LM320T-5*	1.75	NE5020*	5.00	75468CN	.59
LM320T-5.2	1.75	NE563N*	1.25	75454CN	.39
LM320T-8*	1.75	NE565N*	1.75	75491CN	.79
LM320T-12*	1.75	NE566CN*	1.25	75492CN	.89
LM320T-15	1.75	NE567V*	1.85	75494CN	.89
LM320T-18*	1.75	NE567V	1.50	RCA LINEAR	
LM320T-24	1.75	LM703CN	.45	CA3013	2.15
LM323K*	9.95	LM709N	.29	CA3022	2.99
LM324N	1.80	LM709N	.29	CA3035	2.49
LM339N	1.70	LM710N	.79	CA3039	1.35
LM340K-5	1.95	LM711N	.39	CA3046	1.20
LM340K-6	1.95	LM723H	.55	CA3059	3.25
LM340K-8	1.95	LM723N	.85	CA3080	3.35
LM340K-12	1.95	LM733N	1.59	CA3080	.85
LM340K-15	1.95	LM739N	1.00	CA3081	2.00
LM340K-18	1.95	LM741CH	.35	CA3082	2.00
LM340K-24	1.95	LM741CN	.35	CA3083	1.80
LM340T-5	1.75	LM741/14N	.39	CA3086	.85
LM340T-6	1.75	LM747N	.79	CA3089	2.75
LM340T-8*	1.75	LM747N	.79	CA3091	10.95
LM340T-12	1.75	LM748H	.39	CA3123	2.15
LM340T-15	1.75	LM748N	.39	CA3130	1.39
LM340T-18*	1.75	LM1303N	.89	CA3140	1.35
LM340T-24	1.75	LM1303H	1.10	CA3080	1.75
LM350N	1.69	LM1309N	1.49	RC4194	5.95
LM351CN	.65	LM1307N	.65	RC4195	3.25

74LS00 TTL

74LS00	.39	74LS74	.55	74LS151	1.55
74LS02	.39	74LS75	.65	74LS153	1.55
74LS03	.59	74LS76	.79	74LS157	1.55
74LS04	.45	74LS78	.69	74LS162	2.25
74LS05	.45	74LS83	1.10	74LS163	2.25
74LS08	.39	74LS85	2.49	74LS164	2.25
74LS10	.39	74LS86	.65	74LS175	1.95
74LS13	.79	74LS90	1.25	74LS181	3.69
74LS14	2.19	74LS92	1.25	74LS190	2.65
74LS20	.39	74LS93	1.25	74LS191	2.65
74LS21	.45	74LS95	2.19	74LS192	2.65
74LS27	.45	74LS96	1.89	74LS193	2.65
74LS28	.49	74LS107	.65	74LS194	2.25
74LS30	.39	74LS109	.49	74LS195	2.25
74LS32	.45	74LS112	.65	74LS197	1.98
74LS40	.49	74LS122	1.35	74LS240	.95
74LS51	.39	74LS132	1.35	74LS241	.95
74LS55	.39	74LS136	.65	74LS270	.79
74LS73	.65	74LS138	1.39	74LS670	3.99

DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin-out & Functional Description	$2.90
	ALL THREE HANDBOOKS $6.95	

100 PER STRIP MOLEX PINS

Intended for use as an inexpensive substitute for IC sockets. Also perfect for use as board connectors and in subassemblies.

SPECIAL — 100/1.49 — 1000/12.00

CONSUMER ELECTRONICS

PONG SINGLE GAME **$55.00**

SUPER PONG 4 GAMES IN ONE **$79.95**

PONG

FOR YOUR HOME TV

GAMES INCLUDED IN SUPER PONG ARE:
- PONG
- CATCH
- SUPER PONG
- HANDBALL

FEATURES OF PONG AND SUPER PONG
- Incremental speed on volleys increases excitement.
- Playing field adjusts to any size screen.
- Game appears in color or in black & white, depending on television set.
- Unmistakable "PONG" sound accompanies each volley.
- Digital scoring flashes on the screen between each point.
- 2 player challenge or Solitaire!
- Hooks up simply to any model television set, the screen actually becomes the playing field.
- English and other techniques can be used to make any member of the family a Pong champion.
- Battery operated by 4 size "D" flashlight batteries included with the unit.

AC Adaptor (Eliminates Batteries) **$9.95**

DISCRETE LEDS

125" dia.

XC209Red	10/$1
XC209Green	4/$1
XC209Yellow	7/$1
XC209Orange	4/$1

.190" dia.

XC111Red	10/$1
XC111Green	4/$1
XC111Yellow	4/$1
XC111Orange	4/$1

.200" dia.

XC22Red	10/$1
XC22Green	4/$1
XC22Yellow	4/$1
XC22Orange	4/$1
SSL-22RT	4/$1

.185" dia.

XC526Red	10/$1
XC526Green	4/$1
XC526Yellow	4/$1
XC526Orange	4/$1
XC526Clear	4/$1

.200" dia.

XC556Red	10/$1
XC556Green	7/$1
XC556Yellow	7/$1
XC556Orange	7/$1
XC556Clear	7/$1

.085" dia.

MV50 .085" dia. Micro red LED 6/$1

DISPLAY LEDS

TYPE	POLARITY	HT	TYPE	POLARITY	HT		
MAN 1	Common Anode	.270	2.95	MAN 3620	Common Anode-orange	.300	1.75
MAN 2	5 x 7 Dot Matrix	.300	4.95	MAN 3640	Common Cathode-orange	.300	1.75
MAN 3	Common Cathode	.125	.39	MAN 4710	Common Anode-Red	.400	1.85
MAN 4	Common Cathode	.157	1.65	DL701	Common Anode-red	.300	1.85
MAN 7	Common Anode	.300	1.25	DL707	Common Anode	.300	1.50
MAN 7G	Common Anode-green	.300	1.95	DL 726	Common Cathode	.500	2.95
MAN 7Y	Common Anode-yellow	.300	1.95	DL 747	Common Anode	.600	2.25
MAN 52	Common Anode-green	.300	1.75	DL 750	Common Cathode	.800	2.49
MAN 64	Common Anode-red	.400	1.75	DL 338	Common Cathode	.110	.99
MAN 72	Common Anode	.300	1.25	FND70	Common Cathode	.250	.75
MAN 74	Common Cathode	.300	1.59	FND503	Common Cathode	.500	1.29
MAN 82	Common Anode-yellow	.300	1.75	FND507	Common Cathode	.500	1.39
MAN 84	Common Cathode-yellow	.300	1.75				

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	16	15	24 pin	$.38	.37	.36
14 pin	.20	19	18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24	28 pin	$.99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.58	1.43	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.39	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37	24 pin	$1.68	.95	.85
14 pin	.39	.39	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.39
18 pin	.75	.69	.62	40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM		1/4 WATT 5% – 50 PCS.
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM		1/4 WATT 5% – 50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K		
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K		1/4 WATT 5% – 50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K		
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K		1/4 WATT 5% – 50 PCS.
		22K	27K	33K	39K	47K		
ASST. 5	5 ea.	56K	68K	82K	100K	120K		1/4 WATT 5% – 50 PCS.
		150K	180K	220K	270K	330K		
ASST. 6	5 ea.	390K	470K	560K	680K	820K		1/4 WATT 5% – 50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M		
ASST. 7	5 ea.	2.7M	3.3M	3.9M	4.7M	5.6M		1/4 WATT 5% – 50PCS.
ASST. 8R		All Seven Resistor Assortment						$10.95 ea.

5-25	PCS.	.05	ea.	30-95	PCS.	.04	ea.	100-495	PCS. .03 ea. 500-995 .0275 ea.

SINGLE TURN ¾" CERMET POTENTIOMETER

- Resistance Tolerance ± 20%
- High Power –0.5 Watt at 70°C
- Wide Operating Temp. Range –55°C to +125°C

$.89

STANDARD RESISTANCE VALUES

50Ω 100Ω 500Ω 1K 2K 5K 10K 20K 50K 100K 200K 500K 1 MEG

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DPDT				JMP	1	2-9	10-29	30-99
	ON	OFF	ON	231	2.85	2.59	1.97	1.70
	ON	NONE	ON	353	2.59	2.19	1.59	1.43
	ON	OFF	ON	131	2.36	1.99	1.43	1.30
	ON	NONE	ON	133	2.03	1.49	1.21	1.10

MINIATURE TOGGLE

SPDT – SERIES PB, PB1
Momentary Action Switch
Push To Make Contact. And Push Again To Reserve Action

Momentary Action Switch
Normally Open or Normally Closed. Push To Make Contact Between 2 & 1, for N.O. 2 & 3, for N.C and N.O. 1,2,&3

PUSH BUTTON

PB-123 $1.75

PB-126 $1.75

5 AMP RATINGS

THUMBWHEEL SWITCHES

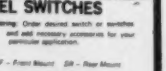
THUMBWHEEL SWITCH ONLY

Part No.	Description	Price
SR 12	Single Pole 10 Position	$7.95
SR 12	Decimal	3.99
SR 21	10 Position BCD only	7.95
SR 31		3.99

Ordering: Order desired switch or switches and add necessary accessories for your particular application.

SF – Front Mount SR – Rear Mount

SERIES SF Front Mount Assembly



SERIES SR Rear Mount Assembly

ACCESSORIES

Part No.	Description	Price
SF EP	End Plate (pair)	$.50
SF DP	Divider Plate (each)	.40
SF BB	Blank Body (each)	.40
SF HB	Half Body (each)	.40

Part No.	Description	Price
SR EP	End Plate (pair)	$.50
SR DP	Divider Plate (each)	.40
SR BB	Blank Body (each)	.40
SR HB	Half Body (each)	.40

DIP SWITCH

These switches feature seven SPST slide switches in a molded dip. They are ideally suited for microprocessor applications.

$1.95

CLIPLITE !! 4/$1.00

NEW LED MOUNTING SYSTEM

- CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8".
- CLIPLITE equalizes and increases the brightness of commonly used wide beam LEDS.
- CLIPLITE is to be used with XC556 LEDS.
- Specify colors–red, green, amber, or yellow when ordering.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	3.3	400m	4/1.00	1N4005*	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006*	800 PIV	1 AMP	10/1.00
IN752	5.6	400m	4/1.00	1N4007*	1000 PIV	1 AMP	10/1.00
IN753	6.2	400m	4/1.00	1N3880	50	250m	6/1.00
IN754	6.8	400m	4/1.00	1N4148	75	10m	10/1.00
1N969	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N969B	10	400m	4/1.00	1N4305	75	250M	20/1.00
1N5232	5.6	500m	2/1.00	1N4734	5.6	1w	28
1N5234	6.2	500m	2/1.00	1N4735	6.2	1w	28
1N5235	6.8	500m	2/1.00	1N4736	6.8	1w	28
1N5236	7.5	500m	2/1.00	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
IN485A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.70
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C35D	10A @ 400V	SCR	$1.95
C39M	35A @ 700V	SCR	1.99
2N2329	1.6A @ 200V	SCR	.99
MDA 980-1	25A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	25A@ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	5/$1.00		PN3567	$.51.00	PN4249	4/$1.00
MPS A06	5/$1.00		PN3568	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00		PN3569	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00		PN3569	4/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00		2N3702	5/$1.00	2N4403	4/$1.00
2N2369	5/$1.00		2N3703	5/$1.00	2N4409	5/$1.00
PN2222A	4/$1.00		2N3704	5/$1.00	2N4410	5/$1.00
PN2222	5/$1.00		2N3705	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00		2N3707	5/$1.00	2N5087	4/$1.00
2N2904	4/$1.00		2N3711	5/$1.00	2N5088	4/$1.00
2N2907A	5/$1.00		2N3724	$.65	2N5089	4/$1.00
2N2925	5/$1.00		2N3725	$1.00	2N5179	5/$1.00
2N3053	2/$1.00		2N3903	5/$1.00	2N5136	5/$1.00
2N3055	$.69		2N3904	4/$1.00	2N5139	5/$1.00
MJE3055	$1.50		2N3905	4/$1.00	2N5203	5/$1.00
MJE2955	$1.50		2N3906	4/$1.00	2N5551	5/$1.00
2N3332	5/$1.00		2N4123	3/$1.00	C106B1SCR	2/$1.00
2N3333	5/$1.00		2N4124	3/$1.00	2N6388	$1.00
2N3638	3/$1.00		2N4125	10/$1.00	40673	1 Mosfet

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.09	.04	.03	.001µF	.09	.04	.035
22 pf	.09	.04	.03	.0047µF	.09	.04	.035
47 pf	.09	.04	.03	.01µF	.09	.04	.035
100 pf	.09	.04	.03	.022µF	.09	.04	.04
220 pf	.09	.04	.03	.047µF	.09	.05	.04
470 pf	.09	.04	.035	1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.09
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	1mf	.37	.29	.17
.01mf	.13	.11	.08	2.2mf	.53	.37	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

1.25/35	.29	.23	.17	1.5/35V	.30	.26	.21
15/35V	.26	.23	.17	2.2/25V	.31	.27	.22
22/35V	.26	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.26	.23	.17	4.7/25V	.32	.28	.23
47/35V	.26	.23	.17	6.8/25V	.38	.31	.25
68/35V	.39	.33	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.10	1.0/25V	.16	.14	.11
10/25V	.15	.12	.10	1.0/50V	.16	.14	.11
10/50V	.18	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.16	4.7/50V	.16	.14	.11
47/25V	.18	.17	.15	10/16V	.14	.12	.09
47/50V	.26	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.26	47/50V	.24	.21	.19
220/25V	.32	.28	.23	100/16V	.19	.15	.14
220/50V	.45	.41	.35	100/25V	.24	.20	.18
470/25V	.53	.39	.27	100/50V	.36	.30	.28
1000/16V	.55	.50	.40	220/16V	.33	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

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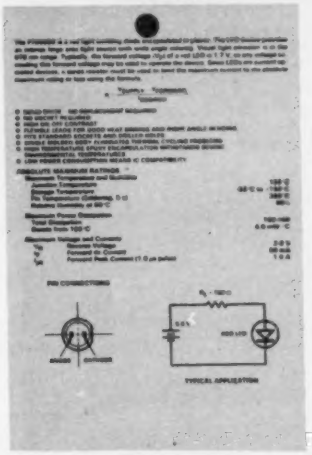
FTK0020

CARD FRONT

FTK0020



CARD BACK

FTK0106

CARD FRONT

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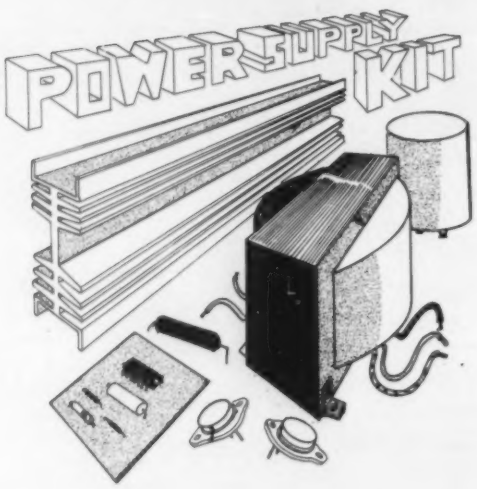

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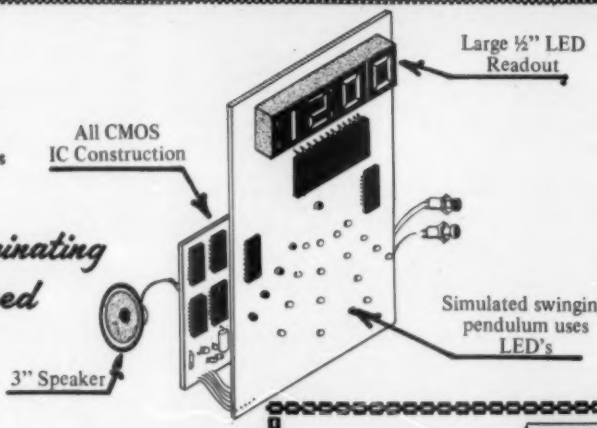

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DRILLED AND PLATED PC BOARDS FOR 5375
Com Cathode - 1.50
Com Anode - 1.50

SCREAM!
AS LOUD AS YOU WANT, BUT OUR LITTLE WARBLE KIT IS LOUDER! COMPLETE DUAL TONE WARBLE ALARM WITH 10 WATT OUTPUT. INCLUDES ALL PARTS AND BOARD.
$2.50
GREAT FOR BURGLER ALARMS
5-15VDC
(Speaker not included)

AUDIBLE CONTINUITY TESTER KITS
A FANTASTIC LITTLE DEVICE THAT HAS A HUNDRED AND ONE USES AROUND THE SHOP AND HOME.
USES:
Code Practice
Continuity Test
Transistor Test
LED & DIODE Test
Tone varies with resistance
$1.95
REQUIRES 3 to 6 VOLT BATTERIES (not included)

50 OHM COAX
SUPER QUALITY COAX SLIGHTLY LARGER IN DIAMETER THAN RG-74 BUT BETTER SPECS
100 ft. ROLL
$3.99

CONTEST! ELECTRONIC DESIGN
Monthly Prize Given for best circuit.
1. All entries become property of BULLET.
2. Entry should include schematic and circuit description.
WATCH THIS SPOT FOR WINNER'S NAME!
$100. GIFT COUPON FROM BULLET

SORRY - NO COD's
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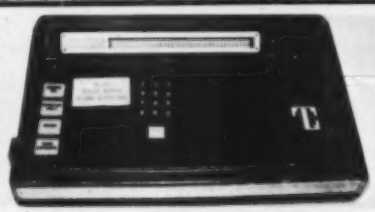
ADD 5% FOR POSTAGE
FOREIGN ORDERS ADD 10% (20% FOR AIRMAIL)
ORDERS UNDER $10. ADD 60¢ HANDLING
TEXAS RESIDENTS ADD 5% SALES TAX

MICROPROCESSOR DISPLAY STATION

These units were part of a complex computer system. The display station contains: 50 key numeric/block alpha keyboard plus others. Display capacity is 768 (12 line of 64), 384, 256, 128 or so on depending on size of characters desired. The viewing screen of the 3" CRT utilizes a high contrast, low persistence, emerald green phosphor. Each display character is composed from a 5x7 dot pattern and registers clearly and sharply against a dark background. Controls provided are: on/off; brightness; focus; and character height. The character size may be adjusted from approximately typewriter size up to ¼" depending upon the number of characters displayed. Character generation was in control unit, which is not supplied. Unit contains keyboard, CRT, drive circuits, with data book and schematics. Use 2513, 2516, or other alpha/numeric generator LSI chips. Great for microprocessor input and output device. Units are used, from airline reservation systems, stock markets, hotel reservation systems, etc.

Sh. Wt. 40 Lbs . . . .6NB60336. . . . $79.50



TOUCH–TONE DATA ENTRY AUDIO TERMINAL

Transcom RCT203 is a versatile data terminal that delivers instant visual verification of sending and receiving hard copy of audio touch tone data, uses regular telephone lines. Use two (2) of these to send and receive with monitoring of visual and audio tone at both stations. Unique strip printer gives hard copy by use of an electrostatic 5x7 dot matrix printer, with 3/8" high characters, 5 characters per inch, 35 digits displayed at all times. Units come complete with power supply, strip printar, touch tone keyboard with oscillators, decoders,electronic logic and other related electronics.

Sh. Wt. 20 Lbs . . . .6MI60268. . . . $49.00
2 for $89.88 . . . .6MI60268 . . . . $89.88/2

VIATRON DATA MANAGEMENT STATION – SYSTEM 21:

Microprocessor assembly, complete with keyboard, CRT, etc. Checked out and in working condition. Only a few left. $595.00

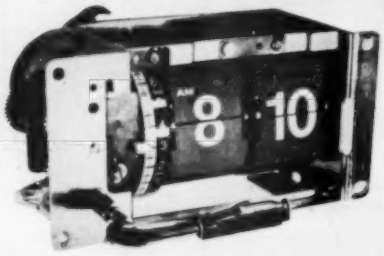
BIG BRUTE SPEAKERS by COMM

New surplus car "stereo" or "CB" speakers for super sound. We purchased a special quanity of the super speakers, which were developed for true hi-fi reproduction. They are of unique design, matched and balanced for stereo and hi-fi systems. All are 8 ohms voice coils. We have only four (4) types at this time. Surface or flush mount. Sold at audio net user price . . . . . way below list price!(see pictures).

Order No. / Mfg. No.	Sh. Wt.	Mag Wt.	pwr wts.	Prices each	pair
BR MB10	2	20	80	$11.88	$19.88
BR 708	1	8	30	$5.88	$10.88
BR 920*	2	20	80	$6.88	$11.88
BR 420*	2	20	80	$8.88	$15.88

*With hi-freq. whizzer cone.

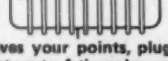
DIGITAL CLOCK & RADIO ALARM



New surplus, by Copal. This unit was part of a radio alarm clock, lighted digital movement, runs on 115 V 60 Hz. Movement has an 8 minu te snooze feature, 10 amp SPDT Alarm switch, with shaft for time and alarm set on front face. The last time we had this type of clock movement the sold out only a few weeks after the catalogs were mailed.....

Sh. Wt. 6 oz. . . . . .6D60316 . . . . . $5.88
4 for $20.00 . . . . .6D60316 . . . . $20.00/4

SENTRY SOLID STATE IGNITION



Solid state ignition saves your points, plugs and gas, ignition parts last up to 4 times longer. Installs in all trucks, vans, cars, and boats quickly and simply, 6 or 12 Volt systems. Improve mileage and performance: no more high-speed miss or spark fall-off. How can you not afford to buy this super item at our price?

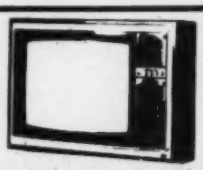
Sh. Wt. 2 Lbs . . . . .6MI60110. . . . $9.75
2 for $18.00 . . . .6MI60110 . . . . $18.00/2

MODERN STANDARD TELEPHONES

A complete modern phone ready for instant use. Factory rebuilt. Available in white, black, beige, pink, red, green, & blue. Ideal for an extra phone, use on intercoms, private systems, extensions, etc. Easy 3-wire hook-up. With hand set, induction coil and cable. Phones shipped may vary slightly from photo. We have many, many different types and styles. When specifying a color, give up to 3 choices in order of preference. Some may not have ringers.

† Standard Desk Dial Phone
Sh. Wt. 8 Lbs (black) . .6VL60440. . $12.50
† Standard Wall Dial Phone
Sh. Wt. 8 Lbs (black) . .6VL60442. . $12.50
† Standard Desk Touch-Tone Phone
Sh. Wt. 8 Lbs (black) . .6VL60444. . $24.50
Sh. Wt. 8 Lbs (color). . .6VL60445. . $27.50
† Standard Wall Touch-Tone Phone
Sh. Wt. 8 Lbs (black) . .6VL60446. . $24.50
Sh. Wt. 8 Lbs (color). . .6VL60447. . $27.50
† 2 Line Standard Desk Dial Phone
This phone has a twist key to switch in 2 lines over the same phone.
Sh. Wt. 8 Lbs (black) . . 6V60448 . . $24.50
† CALL DIRECTOR office style desk dial phone: 10 line phone with hold and intercom buttons.
Sh. Wt. 15 Lbs . . . . 6V60449 . . . . $49.50

COLOR TV CHASSIS



New surplus solid state 'TV' color chassis and related parts, to make an outstanding color TV for peanuts. With these chassis and parts you can build an outstanding color TV for around $100.00. Chassis and parts are from 13", 15", 17", and 19" table color TV's. They are current production models. All chassis supplied with shop tech manuals and data.

† 13" TV CHASSIS with tuners and controls, 6Z60175. . . . . $49.50
† 15" TV CHASSIS with tuners and controls, 6Z60174. . . . . $49.50
† 17" TV CHASSIS only (no tuners) 6Z60173. . . . . $29.50
† 19" TV CHASSIS only (no tuners) 6Z60172. . . . . $29.50
† 17" Quintri-In-Line matrix Picture Tube 6Z60176. . . . . $49.50
† VHF Tuner (for 17" and 19" sets) 6Z60303 . . . . . $8.50
† UHF Tuner (for 17" and 19" sets) 6Z60304 . . . . . $2.50
† Antenna Telescope . . . 5MI00419. . . $1.50
† TV Speaker . . . . . 6Z60177 . . . . . $3.50
† Binding Post Assembly, UHF, VHF 4MI00422. . . . . $1.50
† 2nd Stage Hi-Voltage Boost, 13" and 15" sets 6Z60178 . . . . . $3.50

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Every order includes our latest catalog and insures you of a place on our mailing list

C&S marketing

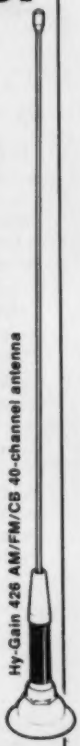
introduces out-of-sight CB that's ready for 40 when you are!

Now! Get the Hy-Gain CB system that's ready for 40 channels when you are. Our out-of-sight Hy-Gain 9 (Model 2679) citizens two-way transceiver and Hy-Gain 426 AM/FM/CB 40-channel antenna.

The great Hy-Gain 9 transceiver goes out of sight in the trunk or under the seat. All that's visible is the hand-held MSR (microphone, speaker and radio) Control Unit with built-in mic and speaker. Disconnects easily. So you can take it with you. Or store it away. Superb performance includes TVI filter to help prevent TV interference.

After January 1 and FCC acceptance, just send Hy-Gain the certificate that comes with the Hy-Gain 9. And $25 for remanufacture. Hy-Gain will remanufacture your radio for all 40 channels! Offer expires June 30, 1977.

The high performance Hy-Gain 426 40-channel AM/FM/CB antenna goes great with the Hy-Gain 9. Replaces standard auto antenna. Looks like original equipment. So you know it's CB. But rip-off artists don't!



$239.95

Hy-Gain 9 (model 2679) sells for $239.95 with Hy-Gain 426 AM/FM/CB antenna. Deduct $20.00 if you don't want antenna.

The following Hy-Gain 23-channel radios can be remanufactured to FCC 40-channel specifications after January 1, 1977 and FCC type acceptance.

681, 682, 2680, 2681, 2682, 2683, 2679, 3084

If you currently own one of these radios, a 40-channel certificate may be obtained from your Hy-Gain dealer.

hy-gain®
We keep people talking.

C&S MARKETING ASSOCIATES

P.O. Box 165
Algood TN 38501
Call Toll Free 800-251-6771
In Tennessee call 800-262-6706

6 Digit LED Clock Kit - 12/24 hr.

$9.95 ea. QTY. 12 OR MORE — $10.95 ea. QTY. 6-11 — $11.95 ea. QTY. 1-5

KIT INCLUDES
- INSTRUCTIONS
- QUALITY COMPONENTS
- 50 or 60 Hz OPERATION
- 12 or 24 HR OPERATION

6-LED Readouts(FND-359 Red, com. cathode)
1-MM5314 Clock Chip (24 pin)
13-Transistors
3-Switches
6-Capacitors
5-Diodes
9-Resistors
24-Molex pins for IC socket

LARGE .4" DIGITS!
ORDER KIT #850-4
AN INCREDIBLE VALUE!

"Kit #850-4 will furnish a complete set of clock components as listed. The only additional items required are a 7-12 VAC transformer, a circuit board and a cabinet, if desired."

Printed Circuit Board for kit # 850-4 (etched & drilled fiberglass) $2.95
Mini-Brite Red LED's (for colon in clock display) pkg. of 5 ..... 1.00
Molded Plug Transformer 115/10 VAC (with cord) 2.50
NOTE: Entire Clock may be assembled on one PC Board or Board may be cut to remote display.
Kit # 850-4 will fit Plexiglas Cabinet II.

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I
3"H,6¼"W,5½"D

CABINET II
2½"H,5"W,4"D

Black, White or Clear Cover

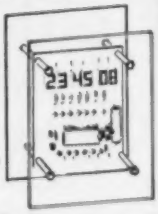
ANY SIZE/COLOR — $6.50 ea. — 2/$12.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" — 95¢ ea. — 4/$3

60 HZ.

XTAL TIME BASE
Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC.
1"x2" PC Board
Power Req: 5-15VDC (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM (Adjustable)
Complete Kit #TB-1 — $4.95 ea.

SEE THE WORKS Clock Kit
Clear Plexiglas Stand



- 6Big .4" digits
- 12 or 24 hr. time
- 3 set switches (back)
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled
Size: 6"H,4⅛"W,3"D

A SUPER LOOKING CLOCK!

Kit #850-4 CP — $23.50 ea. — 2/$45.

6 Digit-LED Clock-Calendar-Alarm Kit

• 12/24 HR TIME • CHOICE OF DIGITS • 28-30-31 DAY CALENDAR • AC FAILURE/BATTERY BACK-UP • 24 HR ALARM - 10 MIN. SNOOZE • ALTERNATES TIME [8 SEC] AND DATE [2 SEC] OR DISPLAYS TIME ONLY AND DATE ON DEMAND • THIS KIT USES THE FANTASTIC CT-7001 CHIP. FOR THE PERSON THAT WANTS A SUPER CLOCK KIT-TOO MANY FEATURES TO LIST!

#7001 B [6 - .4" Digits/Man-64] — **$39.95**
#7001C [4 - .6" Digits/2-.3" Seconds] — **$42.95**

ALL KITS ARE COMPLETE INCLUDING IC SOCKET, TRANSFORMER, LINE CORD, SWITCHES, etc.
Cabinet not included (Ideal fit in Cabinet I above)

½" DIGIT CLOCK KIT

A COMPLETE KIT LESS CABINET. FEATURES: MM5314 IC, 12/24 HR, 50/60 H2, 6-FND-503 LED'S, PLUG-TRANSFORMER, LINE CORD, etc.
[Ideal Fit in Cabinet II]
Kit #5314-5. ..... $19.95 ea. — 2/$38.

JUMBO DIGIT CONVERSION KIT

Convert small digit LED clock to large .5" displays. Kit includes 6-.5" LED's, Multiplex PC Board & easy hook-up info.

Kit #JD-1CC For common Cathode
Kit #JD-1CA For common Anode
$9.95 ea. — 2/$19.

Fairchild Super Digit FND-359

.4" Char. Ht. 7 segment LED RED Com. Cath. Direct pin replacement for popular FND-70.

95¢ ea, 10/$8.50
100/$79.00

CLOCK IC'S

CT-7001	7.95	CT-7002	13.95
MM5314N	3.95	MM5369N	2.50
MM5316N	4.95	MM5375AB	3.95

IC SOCKETS — Solder Tail

Pin	Profile	1-24	25	100
14	LP	$.25	$.22	$.20
16	LP	.28	.25	.23
18	LP	.31	.28	.26
24	SP	.50	.45	.40
28	SP	.60	.55	.50
40	LP	.75	.70	.65

NYLON WIRE TIES
8" for bundle dia. 1/4"-1-3/4" 100/$1.95
4" for bundle dia. 1/16"-3/4" 100/$1.75

SET OF 6 FND-359 WITH MULTIPLEX PC BOARD $6.95

25 AMP BRIDGE
$1.95 ea.
3/$5.00
100 PIV

Form Inexpensive Sockets
100 for $1.25
Reel of 1000 - $8.50

MOLEX PINS

DIODES

IN4002	12/$1.00
IN4003	12/$1.00
IN4005	11/$1.00
IN4007	10/$1.00
2.5A/1000PIV	5/$1.00
IN5400	5/$1.00
IN914	20/$1.00
IN4148	20/$1.00

TRANSISTOR SOCKET GOLD PINS
5/$1.00

SWITCHES

ROCKER SPDT	6/$1.
MINI-SLIDE SPDT	5/$1.
REG. SLIDE DPDT	6/$1.
PUSH BUTTON N.O.	3/$1.

TRANSISTORS 5/$1.00
All Prime Marked Units

2N2222A	NPN	TO-18
2N3415	NPN	TO-92
2N3704	NPN	TO-92
2N4249	PNP	TO-92
2N4400	NPN	TO-92
2N4437	NPN	TO-92
2N5089	NPN	TO-92

TELEPHONE FORMAT KEYBOARD
BY Chomerics

2-1/4"x3"
5/32" thick
$4.95
6/$28.

7-SEG LED

COMMON CATHODE

FND-71	±1	.25"	.75	
FND-359	RED	.4"	.95	
FND-503	RED	.5"	1.35	
DL-33MMB	RED	3x.1"	.75	
DL-750	RED	.6"	2.95	
XAN-654	GREEN	.6"	2.95	(no D.P.)
XAN-664	RED	.6"	2.95	(no D.P.)

JUMBO RED LED's Pkg. of 50 $3.95

10K 10 TURN SPECTROL POT 3/8"x3/8"x1/4" High — SPECTROL #50-4-11-103 — 95c 4/$3.00

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12 or 24 HOUR LED CLOCK

12 VOLT AC or DC POWERED FOR FIXED OR MOBILE OPERATION.

KIT OR ASSEMBLED

MODEL 2001

ACCURATE TIME WITH ADJUSTABLE XTAL TIME BASE

Approx. Size: 1¾"H x 4"W x 4½"D

BATTERY BACK-UP FOR POWER FAILURE OR TRANSPORTING FROM HOUSE TO CAR, ETC.

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM.
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOULDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY (Use When Key Off in Car, Etc.)
- TOP QUALITY PC BOARDS & COMPONENTS - EXCELLENT INSTRUCTIONS

KIT #2001 COMPLETE KIT (Less 9V. Battery) **29.95** EA. 3 OR MORE **$27.95** EA.

115 VAC Power Pack #AC-1 **$2.50** EA.

ASSEMBLED UNITS ORDER #2001 WT WIRED & TESTED (LESS 9V. BATTERY) **$39.95** EA. 3 OR MORE **$37.95** EA. Assembled Units May Be Mixed With Kits for Qty. Price

SCHOTTKY TTL

74S00	$ .35
74S01	.40
74S04	.55
74S05	.60
74S09	.55
74S10	.40
74S15	.55
74S20	.50
74S22	.45
74S40	.45
74S50	.45
74S51	.55
74S60	.85
74S64	.55
74S73	1.25
74S74	.85
74S75	1.75
74S78	1.50
74S86	.95
74S107	.95
74S112	.95
74S113	1.40
74S114	.95
74S121	.95
74S133	.75
74S134	.75
74S138	1.75
74S139	1.50
74S151	1.95
74S153	1.95
74S155	1.95
74S156	1.95
74S157	1.80
74S158	2.50
74S174	2.50
74S175	2.50
74S181	2.95
74S182	1.95
74S251	2.75

DTL

930	$ .09
932	.09
937	.09

LED DRIVERS

7447	$ .95
7448	.95
75491	.65
75492	.65

VOLTAGE REGULATORS

LM 309 H	TO-5	$ .95
LM 309 K	TO-3	1.25
7805	TAB	.95
7812	TAB	1.25
7815	TO-3	1.25
7815	TAB	1.25
78L 15	TO-5	.75
7824	TO-3	1.25
723	DIP	.75
723	TO-5	.75

DIGITAL CLOCK IC's

MM 5312	$ 4.95
MM 5314	3.95
MM 5316	4.95
MM 5375 AB	3.95
CT-7001	7.95
CT-7002	13.95
50380	3.95
MM 5369	2.50

XTAL

3.579545 MHZ.	$ 1.95

UART

AY5-1013	$ 6.95

DIODES

IN 4002	1A, 100 PIV	12/$1.00
IN 4003	1A, 200 PIV	12/$1.00
IN 4005	1A, 600 PIV	11/$1.00
IN 4007	1A, 1000 PIV	10/$1.00
RECTIFIER	2.5A, 1000 PIV	4/$1.00
RECTIFIER	3A, 1000 PIV	3/$1.00
IN 5400	3A, 50 PIV	5/$1.00
IN 914	SIL. SIGNAL	20/$1.00
IN 4148	SIL. SIGNAL	20/$1.00
DIAC	28V.	4/$1.00

PLUG TRANSFORMERS

12 VAC at 150 MA	$ 2.50
12 VAC at 500 MA	3.50

LINEAR

555	TIMER	2/$1.00
556	DUAL TIMER	.95
566	FUNCTION GEN.	1.75
567	TONE DECODER	1.75

IC SOCKETS

PINS	1-24	25	100
14	$ .25	$ .22	$ .20
16	.28	.25	.23
18	.31	.28	.26
24	.50	.45	.40
28	.60	.55	.50
40	.75	.70	.65

MEMORY

2102-1	1 K RAM	$1.95

EXAR

XR 556	$ 1.75
XR 2567	$ 1.95

TRANSISTORS

2N2222A	TO-18	5/$1.00
2N3415	TO-92	5/$1.00
2N3704	TO-92	5/$1.00
2N4249	TO-92	5/$1.00
2N4400	TO-92	5/$1.00
2N4437	TO-92	5/$1.00
2N5089	TO-92	5/$1.00

7-SEG LED's

FND-359	.4" CC RED	$ .95
FND-503	.5" CC RED	1.35
FND-510	.5" CA RED	1.35
DL-750	.6" CC RED	2.95
DL-747	.6" CA RED	2.95
XAN-654	.6" CC GREEN	2.95
XAN-664	.6" CC RED	2.95
TIL-308 A	.3" RED	6.95

NYLON WIRE TIES

8" TIE-WRAP	100/$1.95
4" TIE-WRAP	100/$1.75

MOLEX PINS

REEL OF 1000	$ 8.50
STRIP OF 100	1.25

OP AMPS

3/$1.00	
301	DIP
301	TO-5
709	DIP
741	DIP
741	M-DIP
741	TO-5
747	DIP
748	TO-5

DISCRETE LED's

JUMBO RED

12/$1.00
50/$3.95
100/$7.50

PC TRIM POTS

25K	6/$1.00
4.7K	6/$1.00

MISC. PRIME IC's

FAIRCHILD 9316 (74161)	$ .95
75234 DUAL CORE SENSE AMP	1.50
MM 502H TO-5 SHIFT REG	.95

BUY 100 OR MORE IC's [*Any Mix*] TAKE 10% DISCOUNT.

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7 SWITCHES ON A DIP!

- *Tease Resistant Over-Center Switching Action!*
- *Positive Detent For Tactile Feel!*
- *Dust Resistant Construction!* **Cat. No. 12A2677**
- *Low Profile—0.3" Max. Height Above P.C.*

Each device rocker actuated, SPST. High reliability. 7 different circuits on a DIP IC type housing molded in ECONOMICAL. Housing of heat-resistant glass-filled nylon material. Fits into 14-pin IC socket, or its own two bronze gold-plated connections for PC board use. Each switch rated at (non-switching) 50 VDC 50 ma. Meets MIL specs. Size ⅝ x ⅝ x ⅜".

$1.95

TTL'S *25% OFF

POLY PAKS C-R-A-C-K-S TTL PRICES

BUY 10, TAKE 15% — BUY 100*, TAKE 25%

TYPE	SALE	Cat. No. 12A1981
SN7400N	$0.16	
SN7401N	.16	
SN7402N	.16	
SN7403N	.16	
SN7404N	.16	
SN7405N	.18	
SN7406N	.20	
SN7407N	.23	
SN7408N	.18	
SN7409N	.18	
SN7410N	.16	
SN7411N	.28	
SN7413N	.45	
SN7417N	.32	
SN7420N	.16	
SN7421N	.23	
SN7423N	.35	
SN7425N	.27	
SN7426N	.16	
SN7437N	.26	
SN7438N	.28	
SN7440N	.16	
SN7441N	.84	
SN7442N	.53	
SN7445N	.69	
SN7446N	.79	
SN7447N	.69	
SN7448N	.76	
SN7450N	.16	
SN7451N	.16	
SN7454N	.16	
SN7460N	.16	
SN7464N	.16	
SN7470N	.16	
SN7472N	.34	
SN7473N	.26	
SN7474N	.31	
SN7475N	.49	
SN7476N	.31	
SN7478N	.79	
SN7483N	.69	
SN7485N	.86	
SN7486N	1.05	
SN7490N	.64	
SN7491N	.73	
SN7492N	.47	
SN7493N	.47	
SN7494N	.73	
SN7495N	.79	
SN7496N	.72	
SN74100N	.99	
SN74106N	.85	
SN74107N	.33	
SN74112N	.53	
SN74113N	.68	
SN74114N	.68	
SN74121N	.38	
SN74123N	.89	
SN74125N	.59	
SN74126N	.59	
SN74132N	1.00	
SN74141N	.88	
SN74145N	.69	
SN74150N	.99	
SN74151N	.76	
SN74153N	.65	
SN74154N	1.03	
SN74155N	.70	
SN74157N	.70	
SN74158N	.85	
SN74160N	.85	
SN74161N	.85	
SN74164N	.79	
SN74165N	.99	
SN74166N	1.39	
SN74174N	.97	
SN74175N	.85	
SN74176N	.75	
SN74177N	.79	
SN74181N	2.05	
SN74184N	1.75	
SN74185N	1.75	
SN74190N	1.15	
SN74191N	1.05	
SN74192N	.97	
SN74193N	.93	
SN74198N	.73	
SN74199N	.85	
SN74199N	1.49	
SN74199N	1.49	
SN74200N	3.95	
SN74251N	1.59	
SN74284N	5.95	
SN74285N	5.95	

ECONOMIZE WITH Solar Energy Chips

- 10 Times more potent than cad cells in 10 times less space!
- From space projects to hobby!
- Fraction of original cost!
- Rectangular shapes save space!

These chips were used by the National Aeronautical Space Agency (NASA) for SPACE & TELEPHONIC COMMUNICATION SATELLITES! Forced to unload due to the economy pinch; factory & POLY PAKS now give you these nifty chips to stimulate all energy-economy-minded hobbyists. **Complete Solar to Electrical Energy!**

We are stocking 4 sizes: measured in centimeters 1 x 2, 2 x 2, 2 x 4, 3 x 3 linked together. Silicon "thin plate" forms the basis of the cell. It's a Space Saver! Each cell (chip) generates 0.5 volts, but at different current capabilities. Solder edges for easy "multiple chip building". Each cell has blue-reflective-coated-surface and with transparent protection.

Cat. No.	Type	Size	MA	MV	Sale	3 for
12A3239	N3160C	2 x 1	50	21	$1.49	$3.99
12A3230	N3200C	2 x 2	100	43	1.98	5.00
12A3233	N1205	2 x 2	100	1	3.49	9.90
12A3231A	N3400C*	2 x 4	200	85	3.95	9.90
12A3231B	N4320C*	4 x 2	200	85	3.95	9.90

† Two 1 x 2's shingled together; equals 1 volt
* State 1st and 2nd grid choices.

1 oz

FILAMENT TRANSFORMER PANIC

- ALL 115 VAC INPUT
- STANDARD MOUNTING

Cat. No.	Output	Amps	Wt.	Sale	3 for
12A2768	6.3V	3.	6-ozs.	$2.95	$8.00
12A2266	12. V	.5	9-ozs.	1.98	5.00
12A2474	12. V	1.	1-lb.	2.98	8.00
12A3448	12. V	2.	2-lbs.	3.50	9.00
12A3773	48. VCT	2.	2-lbs.	3.95	8.00

Cat. No. 12A3397

PowerDIP SOLID STATE 5V DC RELAYS

2 FOR $10 — $6.50

- Operates directly from C-MOS (.µs control sensitivity)
- TTL/DTL Compatible (7 milliamp control current)
- Switches up to 4 amps without heat sinking

CHOOSE ANY BARREL KIT

LISTED IN THIS MAGAZINE

FREE WITH $25 ORDERS

LARGEST CLOCK PANEL!

• 1.2" HIGH, 4-DIGIT, 7-SEGMENT

- Orange, gas discharge!
- AM-FM indicators!
- Flashing seconds!
- 12 hour!

Interfaces directly to MM5316 chip which we are offering FREE! Cat.No.12A3248

We have never seen a digital clock panel with characters so high, orange color so bright. It's by far the finest panel we've sold. The substrate is "sandwiched" between ⅛" thick panels of glass. Each of the printed circuit pins is lettered or numbered to correspond pin-for-pin interfacing with the famous MM5316 clock chip, which WE GIVE FREE! Power requirements 170 volts for anode, 1½ mils per segment. Includes colon too! Size 4¼ x 1-9/16". Makes a nifty looking digital clock for home, office, ham or radio station, lab, etc. Wt. 8 oz.

$13.95

Panel 'N Chip

FREE! FREE! Each Clock panel purchase we give MM5316 chip—no charge.

"BLASTAWAY" ON 1N4000 RECTIFIER PRICES

Type	PIV	Sale
1N4001	50	10 for 49c
1N4002	100	10 for 69c
1N4003	200	10 for 98c
1N4004	400	10 for 98c
1N4005	600	10 for 79c
1N4006	800	10 for 89c
1N4007	1000	10 for 99c

3 for $1.29

DELTROL TUBULAR SOLENOID $1.49

Cat. No. 12A3394

It's new! Different! 1st Time we've seen these popular tubular solenoids at this price. Designed for maximum FULL, in minimum space. Features 12VDC @ 450 mils, 23 ohm coil, continuous duty, only ¾ x ⅞", with ½" threaded bushing for panel mtg., ½" stroke. Powerful 17-oz. pull up to 17 oz. pull. All metal frame, black slotted plunger, with pointed end for precision smooth recoil action. With wire connections. Wt. 3 ozs.

- Space saver ¾ x ⅞"
- Powerful 17-oz. pull
- Unique panel mtg.
- Weighs only 3 oz.
- 12 VDC

TOUCH TONE ENCODER KIT*

REPEATER • Mobile talks with! • HOME • OFFICE • FACTORY • Base

$18.88

1.25M, 2-meter and 6-meter amateur radio operators: if your rig is mobile, convert it easily to a mobile telephone station and interface your home, shop, school, factory TTE-100 touch tone encoder kit. Kit includes: Chomerics touch tone pad, Motorola MC14410 chip, trimpot, resistors, ceramic, integrated, and G-10 pc board. Electrical specs: 12-16 volts, 5 mils (max), 4 volts PP output. * Less 1-MC crystal. **Cat. No. 12A3385**

Cat. No.	Description	Sale
12A3149	Touch Tone Pad	$4.50
12A3382	MC14410 Chip	10.50

BUY 'EM SEPARATELY

12A3383 P.C. Board 2.95

These small magnetic proximity reed switches are ideal for all types of burglar alarms. One case contains an Alnico magnet, which actuates a Normally Open reed switch in the other case within a distance of 1". Mount on windows & doors. Cat.No.12A3163

PROXIMITY REED SWITCHES FOR BURGLAR ALARMS

$1.50

FULL EPOXY SILICON BRIDGE RECTIFIERS

WAVE PIV	2 Amp	6 Amp	10 AMP
50	$ .99	$ .99	$1.49
100	.99	1.09	1.69
200	.99	1.25	1.99
400	1.19	1.50	2.09
600	1.39	1.75	
800	1.59	1.95	
1000	1.79	2.25	

Code: 2 amp TO-5 case

6 Amp 1/3 x 1/3 x 5/16 sq.

CITIZENS BAND POWER SUPPLY

3 for $60.

$22.50

- 12 VDC @ 3 AMPS
- REGULATED, CONTINUOUS DUTY
- CONVERTS CB, HAM RIGS TO HOME
- COMPLETELY WIRED

115V to 12VDC converter! Built-in automatic RESET circuit breaker. Powerful 3 amps (6 amps peak) makes it ideal for SSB rigs, too! Attractive walnut like metal modern-design cabinet (8x 4½ x 2¾"). Big U.S. maker design. Built-in circuit breaker. Front panel has OFF-ON switch and LED light. For 115 VAC 60 cycle. Wt. 6 lbs. Cat. No. 12A3462

DIGITAL CLOCK

. . . 4-digit, 0.5" Digital Clock, LED, built-in red filter, with a MM5385 multi-function alarm chip, mounted on a 3 x 1¾ x ⅛" module. Has all necessary discrete components mounted on module by factory, to require only 6 function switches, brightness and voltage divider control, 12-16 volt filament transformer, AC line cord and case. Makes easi-built-in alarm and radio output; switch functions: Seconds, Sleep timer up to 1 hour, fast set, Snooze alarm display (tells you when snooze alarm triggers), Alarm display (tells you when alarm triggers).

Cat. No. 12A3411

MODULE WITH BUILT-IN "CHIP"

$14.95

Alarm ON/OFF. Instruction and hookup diagrams. Shpg. wt. 7 ozs.

ECC INDUSTRIAL SPEED CONTROL

3 for $14

$4.95

Repeat of a sellout! A $30 item, made by ECC famous for semiconductors, designed and built this speed control for XEROX. Controls home, shop and industrial lighting too. Rated at 1300 watts. A very elaborate circuit for controlling many electrical and electronic devices. Easily controls speeds of electric drills, brush type motors, etc. Built with heavy duty aluminum framing. Complete with external 50K pot, for variable speed control, and series resistor. Heavy duty colored wires for 115VAC 60 cycles, and item to be controlled. 10/32 mounting stud. Outperforms our previous sell-out. With hookup diagram. Use as temperature controller too. Wt. 2 lbs. Cat.No.12A3392

$8.88

- 115 VAC!
- Compact!
- Lightweight!
- Only 4-11/16" sq. x 1½" deep!

Rotron Fans

Fans by Rotron. Used extensively for hi-fi eqpt because of low-cost, dependable cooling, as well as flushing computers, power supplies, office equipment, light projectors, transmitters, receivers & more! Weighs only 1-lb. LOW NOISE LEVEL! Humidity & moisture resistant motor. REVERSIBLE AIR FLOW! Impedance protected. Suitable for −40° to +160° F. Both 115 VAC, 3200 rpm, 15 watts, .16 amps. Hi-impact, flame retardant polycarbonate propellers in a reinforced phenolic venturi block. Removed from new equipment. Money back guarantee. 1½ lbs. **12A3108 "Muffin" 3-blade**

• Uses Encoder MOS ROM • 7 "LED" test feature • 4 Modes • 53-key keyboard

KEYBOARD & ENCODER KIT

$69.95 WIRED

$59.95 KIT

Lowest price Keyboard and Encoder kit we've seen. General purpose ASCII keyboard for data terminal applications. Could be used for TV, RTTY, Code Transmission, Altair and other Mini Computers, etc. Utilizes 2-key rollover MOS memory allowing encoded outputs to be strobed out as each key is depressed. Uses double/side pc board. Electronic shift lock, not mechanical on keyboard. Keyswitches, one integral assembly not individual keys. Keyboard: 53 keys (49 encoded keys). 4 mode: normal, shift and control. 3 internal function keys: shift lock on side of board, shift lock and control. 3 functions: Key Break, Here Is, Repeat. 7 additional functions (can be assigned by user).

- Double sided PC board
- Outputs — standard ASCII 7 bits plus strobe

Electrical specs: voltage requirements plus 5 volts and minus 12 volts, 200mw, negative or positive logic output, jumper selectable. Output connector. On the PC board we have A NEW KEYBOARD TEST FEATURE . . . 7 LEDS! These LEDs display visually the ASCII code for the depressed key. TTL compatible. Kit includes: 53 key keyboard, pc board, ROM, 7 LEDs, resistors, capacitors, TTL IC's and SOCKETS. We include diagram and wiring instructions. ROM code. Wt. 7 lbs. Size overall: 13 x 5½ x 2".

Cat. No. 12A3208 Keyboard & Encoder Kit . . $89.95
Cat. No. 12A3209 Keyboard & Encoder Wired $69.95

FAIRCHILD, NATIONAL VOLTAGE REGULATOR PANIC

YOUR CHOICE $1

3 for $2.75

- 1-AMP RATING
- TO-220 or TO-3 CASES
- POSITIVE OR NEGATIVE

Volts: 5 ☐ 8 ☐ 12 ☐ 15 ☐ 18 ☐ 24 ☐

Cat. No. 12A3449 Positive Voltage**
Cat. No. 12A3450 Negative Voltage**

** State voltage and case style when ordering.

Terms: Add postage Rated: net 30
Phone: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield.
MINIMUM ORDER — $6 (Plus Postage)

SALE — Send for FREE Fall-Winter CATALOG

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6-DIGIT ELECTRONIC STOP WATCH KIT

$39.95

- Lowest prices anywhere!
- Split action timing!
- Makes mechanical stop watches obsolete!
- Indispensable for schools, labs, hobbyists, sports, racing fans!

Never before offered! Start, split, stop, reset with one hand. Features accuracy of .002%. Fail-safe design so timings won't be accidentally reset. Displays MINUTES, SECONDS, TENTHS and HUNDREDTHS of seconds, up to 59 minutes, 59.99 seconds. Bright LED display. Split action allows freezing partial event time, then reading elapsed time since first reading (allows timing 2 or more participants in the same event). Built-in jack for remote on-off. Case made of hi-impact plastic, designed to fit snugly in hand. Thumb starts and stops, middle finger resets, index controls split. Has battery charging jack. EASY TO BUILD! Complete with step-by-step instructions. Size: 3¾ x 6½ x 1¼". Uses AA penlight NICAD batteries (see our Cat. No. 92CU3453). Wt. 3 ozs. Cat. No. 12A3502 Kit 12A3504 Wired $44.00

LASER "BEEM-O-LITE" DIODES

3 for $24

$8.88

LASD-59

NEVER BEFORE OFFERED (as far as we know)! Type LASD-59. With power rating of 5 to 9 watts, transmitting a powerful ray of infrared light. Designed in hetero-junction coaxial type structure. N-Type. For "PULSE" mode operation. Wavelength approx. .904 m., 3 volts reverse voltage, threshold current 10, emitting area 6 x .09. Max. peak fwd current 40. YOU MUST FOLLOW THE LASER SAFETY RULE accompanying laser diode. Gold encased. Size: .25" diameter, ⅞" high. 4/40". Cat. No. 12A3505

Poly Pak's EXCLUSIVE BARREL KITS®

Avg. Ship Wt. 6 ozs.

100'S OF BARRELS PURCHASED!

For the first time anywhere, Poly Pak merchandisers introduce a new way in buying the economical way. Raw stock from the "barrel". Remember the "good ole days"? They're back again. The same way merchandisers throughout the United States buy from various factories ... their overruns in barrels. Poly Pak has done the same. Therefore you are getting the same type of material as the RE-TESTERS DO!

TEST 'EM YOURSELF 'N SAVE

$1.98 YOUR CHOICE OF ANY KIT

Buy 10 BARREL KITS AND CHOOSE THE 11TH KIT Free

KIT	
#1—SN7400 DIP IC'S Cat. No. 12A2415, untested	☐ 75 for $1.98
#2—LINEAR OP AMPS Cat. No. 12A 2416, untested	☐ 75 for $1.98
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#7—VOLUME CONTROLS Cat. No. 12A2421, 100% good	☐ 40 for $1.98
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#11—POWER TAB TRANS Cat. No. 12A2425, untested, npn	☐ 40 for $1.98
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#15—MOS FET TRANSISTORS Cat. No. 12A2429	☐ 60 for $1.98
#18—DIPPED MYLARS Cat. No. 12A2597, 100% good	☐ 60 for $1.98
#20—LONG LEAD DISCS Cat. No. 12A2598, 100% good	☐ 150 for $1.98
#26—PLASTIC TRANSISTORS Cat. No. 12A2604, untested	☐ 100 for $1.98
#30—PRE-FORMED RESISTORS Cat. No. 12A2608, 100% good	☐ 250 for $1.98
#35—NEON LAMPS Cat. No. 12A2613, 100% good	☐ 30 for $1.98
#37—1-AMP BULLET REC Cat. No. 12A2615, untested	☐ 100 for $1.98
#39—2N3055 TRANSISTORS Cat. No. 12A2617, 100% good	☐ 15 for $1.98
#40—HI-POWER PNP TRANS Cat. No. 12A2618, 100% good	☐ 20 for $1.98
#53—JUMBO RESISTOR PAK Cat. No. 12A2731, 100% good	☐ 100 pc. $1.98
#54—8 DIGIT READOUTS Cat. No. 12A2722	☐ 7 for $1.98
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#65—MIXED READOUTS Cat. No. 12A 2733, untested	☐ 15 for $1.98
#68—2 WATTERS Cat. No. 12A2735, 100% good	☐ 100 for $1.98
#71—CAPACITOR SPECIAL Cat. No. 12A2738, 100% good	☐ 100 for $1.98
#73—TRANSISTOR ELECTROS Cat. No. 12A2747	☐ 50 for $1.98
#76—1 WATT ZENERS Cat. No. 12A2741, untested	☐ 100 for $1.98
#83—LM340T VOLT REG Cat. No. 12A2836, untested	☐ 15 for $1.98
#86—HOBBY LEDS Cat. No. 12A2989, untested	☐ 40 for $1.98
#87—NATIONAL IC BONANZA 12A 2960, untested	☐ 100 for $1.98
#88—LITRONICS LED READOUT	☐ 10 for $1.98
Cat. No. 12A2861, all mixed	
#91—SILVER MICAS Cat. No. 12A3018, variety	☐ 100 for $1.98
#92—3 AMP EPOXY RECT Cat. No. 12A3204, untested	☐ 100 for $1.98
#93—HALF WATTERS Cat. No. 12A3046, 100% good	☐ 200 for $1.98
#98—PHOTO ELECTRIC CELLS Cat. No. 12A3082, 100% good	☐ 10 for $1.98
#104—SLIDE VOL CONTROLS Cat. No. 12A3097, 100% good	☐ 10 for $1.98
#109—TERMINAL STRIPS Cat. No. 12A3136, wide asst	☐ 150 for $1.98
#110—SUPPRESSOR DIODES Cat. No. 12A3137, untested	☐ 50 for $1.98
#112—MICRO MINI LEDS Cat. No. 12A3139, variety	☐ 40 for $1.98
#115—MOLEX SOCKETS Cat. No. 12A3144, 100% good	☐ 200 for $1.98
#119—PRECISION RESISTORS Cat. No. 12A3208, 100% good	☐ 100 for $1.98
#121—MINI MAGNETS Cat. No. 12A3168	☐ 100 for $1.98
#126—UPRIGHT ELECTROS Cat. No. 12A3226, 100% good	☐ 40 for $1.98
#127—AXIAL ELECTROS Cat. No. 12A3227, asst	☐ 40 for $1.98
#128—MINI DIP IC'S Cat. No. 12A3245, untested	☐ 75 for $1.98
#130—CRYSTALS Cat. No. 12A3280, many in 5mc	☐ 12 for $1.98
#131—TANTALUM ELECTROS Cat. No. 12A3286, mixed	☐ 30 for $1.98
#133—C-MOS IC'S Cat. No. 12A3257, untested	☐ 60 for $1.98
#136—PANEL SWITCHES Cat. No. 12A3268, by Oak	☐ 30 for $1.98
#140—LAMPS, INDICATORS Cat. No. 12A3297, many types	☐ 20 for $1.98
#141—10 WATT ZENERS Cat. No. 12A3298, good yield	☐ 15 for $1.98
#144—RCA PHONO PLUGS Cat. No. 12A3293, 100% good	☐ 40 for $1.98
#149—ROCKER SWITCHES Cat. No. 12A3302	☐ 25 for $1.98
#158—MAGNIFIED MAN-3s Cat. No. 12A3325, less rejects	☐ 12 for $1.98
#159—MODULAR SWITCHES Cat. No. 12A3190, Centralab	☐ 25 for $1.98
#160—LM309KC V. REG Cat. No. 12A3330, untested	☐ 15 for $1.98
#161—PLASTIC TRANSISTORS Cat. No. 12A3343, 100% material	☐ 25 for $1.98
#162—MINI TRIMPOTS Cat. No. 12A3345, for p.c.	☐ 30 for $1.98
#172—25 AMP SCRS Cat. No. 12A3336, 100% material	☐ 3-pcs. $1.98
#173—25 AMP TRIACS Cat. No. 12A3336, 100% material	☐ 3-pcs. $1.98

HI-POWER NPN TRANSISTOR

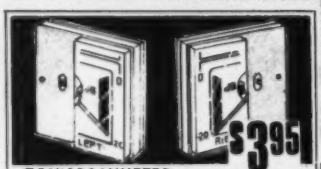
$1.95

Type TO-3 similar to RCA. Rated @ 150 watts, 30 amps, 60 to 140 vceo, up to 60 HFE. Supercedes the 2N3055. Silicon. 2N3772

Cat. No. 12A3497

CHOOSE ANY BARREL KIT LISTED IN THIS MAGAZINE FREE WITH $25 ORDERS

50 MICROAMMETER MOVEMENT!



$3.95 SET OF 2

LEFT & RIGHT CHANNEL BALANCING METERS

Unusual, unique! This set of meters used in the finest hi-fi stereo eqpt. Each meter indicates 0 to minus 30 db of sound. One meter indicating "RIGHT" for right channel and the other "LEFT" for left channel. 1¼" sq. see-thru plastic case. For precision balanced sound in stereos! Wt. 4 oz. Cat. No. 12A3332

THE PURIFIER 10.7 mHz CERAMIC FILTER

Made for RCA

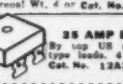
3 for $5. **$1.98**

ATTN HAMS & AUDIOPHILES! Sharpen up your 2-meter rig or stereo system. Offers unbeatable selectivity and sensitivity. In a mini shielded can, only ¾ x 3/16 x 7/16". No tuning needed. Precision bandpass filters sell for $7. Have many $$$. Similar units have 3 db bandwidths of 240 kHz, 50 db bandwidth: 700 kHz. Ripple: 1 db. Impedance 300-500 ohms. Wt. 1 oz. Cat. No. 12A3467

25 AMP BRIDGES

By top UB maker. 4-lug type leads. 4 on Cat. No. 12A3273

PIV	SALE
50	$1.95
100	2.35
200	2.98
400	3.50
600	3.75
800	4.35



MV-5054 HI-POWER LED

Illuminates ½" dia. circle. Hi-intensity for panel mtg. .340" R. red lens. .250" diameter. No. 12A3487

15 for $1.98

SGS-ATES 4-WATT* AUDIO AMP

Cat. No. 12A3334

3 for $2.50 **$1**

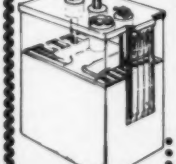
That's right! ONE DOLLAR! Basic unit rated @ 2 watts, but properly heat sinked can handle 4 watts. Similar to their type number TAA-621. Specs based on speaker v.c. of 8 16 ohm imp. 14 sig-nag pins, dip, with metal top. Basic specs: self-centering bias, low quiescent output current 2.5 mils. Any supply voltage from 6 to 24V. 18 transistor circuitry. Direct coupled input, high input impedance. Voltage gain 72 db. Output current 220 mils. With specs & typical applications. Wt. 1 oz.

100 MICROAMP PANEL METER!

$3.50 2 for $9.

Rectangular "C" thru plastic case. Face has no numbers. Use for tuning level, VU, S-meter. Can be lighted. Size 1½ x ⅞ x 1⅛". Wt. 1 oz. Cat. No. 12A3464

HIGH AMPERAGE ENERGY POWER PAKS



$5.95

3 for $16

- 2 VDC @ 20 Amps
- Made by Willard
- Type 20-2

Most versatile energy battery power pak we've seen. Imagine 20 amps @ 2 volts. Gang 'em! Get all kinds of voltages and current capabilities — for emergency supplies, and other appl. or areas requiring such a device. Less electrolyte. Has 3 color balls showing proper level of electrolyte. Size: 5 x 3½ x 2¾". Wt. 5 lbs. Plastic C-thru heavy-duty case.

Cat. No. 12A3329

$1.50

FAIRCHILD 0.5" 7-SEG. READOUT

Type FND-507. Reflective bar type, LED. Color Red. 1.7V @ 20 mils per segment. Common anode. Right hand decimal. PC pin right hand decimal. PC board type. 0.65 x .59 x .3 overall. No. 12A2950

FND-500. Common cathode. No. 12A2949

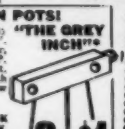
PRECISION POTS!

By FAIRCHILD! *Exact: 1¼ long x 5/16 x 5/16". Features 25 turns, linear, similar to Bourns 224P. 5% tolerance. 1 watt. Hermet gray in color. With 3 gold plated leads. Screw driver adjust.

Cat. No. 12A3436

Ohms	Ohms	
☐ 25	☐ 500	☐ 10K
☐ 50	☐ 1K	☐ 25K
☐ 100	☐ 2.0K	☐ 50K
☐ 200	☐ 2.5K	☐ 100K
	☐ 5K	☐ 250K

"THE GREY INCH"®



2 for $1

"Fast Charge" AA NICADS

$1.69 3 for $4.80

Most commonly used nicad battery: 1.2VDC 500 mils. Fast charge, only requires 5 hours, others 12 to 24 hours Cat. No. 12A3493

MEMORIES!

☐ 8008	$14.95
☐ 2101-1	1.95
☐ 2102	1.50
☐ 2102-1	1.95
☐ 2102-2	2.25
☐ 2111	3.50
☐ 2112	3.50
☐ 1101	.88
☐ 1103	1.00
☐ 1702A	8.88
☐ MM5204	11.50
☐ MM5260	1.00
☐ MM5262	1.95
☐ MM5203Q	8.88
☐ MM5202Q	5.95

- By large U.S. maker!
- 4 Jumbo 0.6 LED digits!
- B-e-e-p-e-r alarm!
- Flashing seconds!
- Minimum of parts!

$29.95 Cat. No. 12A3489

"BIG BING BEEPER" DIGITAL ALARM CLOCK KIT!

Never before offered! Never before in kit form! U.S. midwest factory (sorry can't name it) says "it is so popular wired, why not have a kit to the hobby market?" WE AGREE! Wired, the suggested list price by the original factory to the department stores was $49.95. Beautifully designed, attractive enough for any home, room, office. All controls in front, makes visionary control easy. Features: 3 x 6½" wide sloped woodtone/beige case. Uses famous all LED 0.6" high digits, Mostek 50389 "clock chip", with built-in beeper alarm circuitry. Front panel controls. ON-OFF ALARM, hour set, 10 minute set, hold, alarm set buttons. Flashing seconds colon, with speaker, audible beeper alarm. Includes backup power failure feature, 24-hour alarm. 115VAC 60 hz power supply. Drawer feature for extra sleep. For the first time the highest quality factory product at low, low prices and NOW IN KIT FORM. Wt. 3 lbs. Easy to build!

Terms: Add postage **Rated:** net 30
Phone: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield,
MINIMUM ORDER — $6.00

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SALE ☐ Send for FREE Fall-Winter CATALOG

C.O.D.'s MAY BE PHONED

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S.D. SALES CO.

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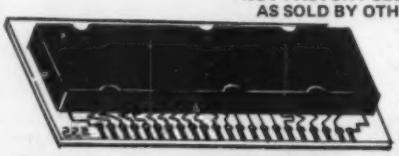
Stick It!

IN YOUR CLOCK,
IN YOUR DVM, etc.

HUGE SPECIAL PURCHASE!
NOT FACTORY SECONDS
AS SOLD BY OTHERS.



4 JUMBO .50 IN. DIGITS
ON ONE "STICK"!
(With Colons and AM–PM Indicator)

$3.95

BUY 3 for $10.00

BOWMAR
4 DIGIT LED READOUT ARRAY

The Bowmar Opto-Stick. The best readout bargain we have ever offered. Has four common cathode jumbo digits with all segments and cathodes brought out. Increased versatility since any of the digits may be used independently to fit your applications. Perfect for any clock chip, especially direct drive units like 50380 or7010. Also use in freq. counters, DVM's, etc. For 12 or 24 hour format.

1024 BIT RAM's – 59¢

8 for $4.00

Prime 1103 1K dynamic RAM's. Organized 1024 x 1. Packaged in expensive military quality 18 pin ceramic DIP's with gold plated pins. 300 NS. Typical access time. For either the computer hobbyist or professional this is the best RAM buy anywhere! With spec. sheet. Originally cost a computer mfg. over $3. each! At this price – sold on a first come first served basis.

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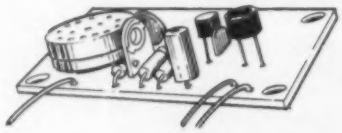
7408 – 8/$1.	PLEASE SPECIFY THAT	7438 – 5/$1.
7420 – 8/$1.	YOU ARE ORDERING	74141 – 3/$1.
7437 – 5/$1.	HOUSE NO. TTL	74153 – 3/$1.

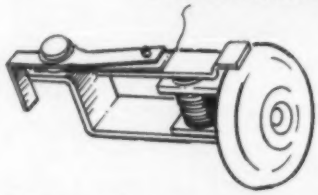
VOICE ACTIVATED SWITCH



$1.49

Has mike that drives a transistor amp. that turns on a SCR. Perfect for experimenters.

MINI ALARM BELL



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Works on 1½VDC. Perfect for all kinds of alarm applications, etc. A perfect bell for the "whistle and bell" section of your ALTAIR or IMSAI.

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74LS00 – 49c 74132 – $1.70
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12 VDC VOLTAGE REGULATOR
7812 – TO-220 – RATED 1 AMP.

99¢

PANEL METER
FOR DC POWER SUPPLIES

$2.95

F.S. = 1 MA. DUAL SCALE: 0–30V, 1–1.5 A.

PRICE CUT ON LOW POWER 2102

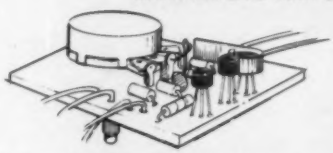
21L02–1. Low Power, 500 NS. Static Ram

8 for $12.95

MOTOROLA SCR
2N4443 – 8 AMP 400 PIV

P.C. LEADS 2 for $1.00

MINI AUDIO AMPLIFIER



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3 Transistor amplifier. Originally used in mini phonograph. Perfect for the experimenter.

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8080A	By AMD. Outperforms INTEL	$24.00
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8224	Clock Generator	4.95
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8830	Dual Line Driver	1.75
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MC1489	TTL to RS232	1.50
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low cost!

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Axial Lead. 8000 MFD. 15 WVDC.
95c each Computer Grade!
Limited Quantity

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Black anodized aluminum "U" Shaped. Fits TO–220 case.
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The most popular digital IC's ever produced. Very hard to find.

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UL 923	JK FLIP FLOP	$1.19

ALL IN TO–5 8 LEAD PLASTIC CASE.

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4K LOW POWER RAM BOARD KIT

THE WHOLE WORKS

Imsai and Altair 8080 plug in compatible. Uses low power static 21L02–1 500 ns. RAM's, which are included. Fully buffered, drastically reduced power consumption, on board regulated, all sockets and parts included. Premium quality plated thru PC Board.

$89.95

8 Digit LED
"METRIC MASTER"
$19.95

"RAPID MAN – 12"
$29.95

$1,000,000 CALCULATOR PURCHASE!

We bought the entire stock of a major manufacturer. New, guaranteed units.

Five functions PLUS complete Metric Conversion functions. Rechargeable batteries. Small, hand held size. With AC charger.

12 Digit – Desk Top Style. Sturdy design. With memory and four complete functions. Big, bright display.

ALARM CLOCK KIT SIX DIGIT LED

Thousands of hobbyists have bought and built our original clock kit and were completely satisfied. But we have received many requests for an alarm clock kit with the same value and quality that you have come to expect from S. D. So, here it is!

THE KIT INCLUDES:
1 Mostek 50252 Alarm Clock Chip
6 Hewlett Packard .30 in. common cathode readouts
15 NPN Driver Transistors
2 Switches for time set
2 Slide Switches for alarm set and enable
1 Filter Cap
4 IN4002 Rectifiers
1 IN914 Diode
1 .01 Disc Cap
15 Resistors
1 Speaker for alarm
1 LED lamp for PM indicator

$9.95

PCB – $3.00
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60 HZ CRYSTAL TIME BASE – FOR DIGITAL CLOCKS S. D. SALES EXCLUSIVE! **$5.95**

KIT FEATURES:
A. 60 hz output with accuracy comparable to a digital watch
B. Directly interfaces with all MOS Clock chips
C. Super low power consumption (1.5 Ma typ.)
D. Uses latest MOS 17 stage divider IC
E. Eliminates forever the problem of AC line glitches
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G. Small size, can be used in existing enclosures.

KIT INCLUDES CRYSTAL, DIVIDER IC, PC BOARD PLUS ALL OTHER NECESSARY PARTS AND SPECS.

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Brand new, factory prime. Hard to find, but still used in a variety of projects. (See the RTL Cookbook by Howard W. Sams.)

MC724P – 59c	MC780P – 89C	MC791P – 69c
MC725P – 59c	MC785P – 49c	MC792P – 59c
MC764P – 49c	MC787P – 89c	MC799P – 59c
MC767P – 69c	MC788P – 49c	MC970P – 89c
MC771P – 49c	MC789P – 59c	MC9709P – 69c
MC775P – 89c	MC790P – 89c	MC9760P – 69c

TTL INTEGRATED CIRCUITS

7400	– 19c	7430	– 19c	7476	– 35c	74153	– 75c
7402	– 19c	7432	– 34c	7480	– 49c	74154	– 1.00
74L04	– 29c	7437	– 39c	7483	– 95c	74157	– 75c
74S04	– 44c	7438	– 39c	7485	– 95c	74161	– 95c
7404	– 19c	7440	– 19c	7586	– 45c	74164	– 1.10
7406	– 29c	7447	– 85c	7490	– 65c	74165	– 1.10
7408	– 19c	7448	– 85c	7492	– 75c	74174	– 95c
7410	– 19c	7451	– 19c	7495	– 75c	74181	– 2.50
7411	– 29c	7453	– 19c	7496	– 89c	74191	– 1.25
7413	– 50c	7473	– 39c	74121	– 38c	74192	– 1.25
7420	– 19c	7474	– 35c	74123	– 65c	74193	– 1.00
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"CUBO" –DIGITAL ALARM CLOCK CUBE
A PERFECT GIFT – NOT A KIT!

The CUBO Alarm Clock mfg. by Corvus, division of MOSTEK CORP. Originally sold for $49.95. We bought out their entire inventory. All new, individually gift boxed. Mini size (2½" cube) with maxi performance.

FEATURES:
A. 4 Digit H.P. Bright Display
B. "Second Hand" LED Activity Indicator
C. 24 Hour Alarm; 12 hour real time format
D. 10 Minute Snooze
E. Auto Display Dimming – Adjusts to Ambient Light
F. AM/PM Indicator
G. Power Failure Indicator
Uses Famous Mostek MK50250 MOS LSI IC

$14.95 EACH (Add 75c P.&H.)

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Rated 35 WVDC. Upright style with P. C. leads. Most popular value for hobbyists. Compare at up to $1.19 each from franchise type electronic parts stores.

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Back in Stock!

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NEW – $6.95 with data
LIMITED QUANTITY

74S200
256 Bit High Speed RAM
Same as 82S16
$3.95

FAIRCHILD BIG LED READOUTS

A big .50 inch easy to read character. Now available in either common anode or common cathode. Take your pick. Super low current drain, only 5 MA per segment typical. **YOUR CHOICE: 6 for $7.50**

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By AMD

8080A	Better than Intel	$24.00
8008-1	High Speed 8008	12.50
8212	I/O Port	3.50
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2513	Character Generator	10.00

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82S129. 256X4. Bipolar, 50 NS. FAST. WITH SPECS.
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TIME IS OF THE ESSENCE

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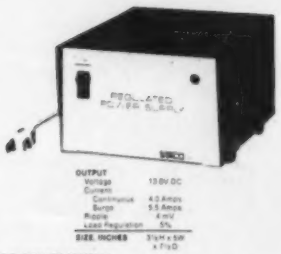

STACO POWER SUPPLY.
Converts Standard Household Voltage into Regulated 13.8VDC @ 4A. Ideal for Car Radios, Tape Players, Mobile C.B. Radios & Communications Equipment. Suitable for 12V Trickle Charger and as Bench Supply for experimenters. Automatically protected from overloads and short circuits. Full 90 Day Warranty!
RPS-4.....$37.95 ppd. (U.S.Only)
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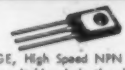
DC to DC CONVERTER MODULE. Tiny potted module is complete regulated output up-converter. 4.5VDC input provides approximately 14V @ 12mA. Will operate down to 2.5V with reduced output. Operate digital clocks from 3 or 4 1.5V batteries or put a clock in your old 6V car. Only 1"X1"X¼" potted module. W/diagram DCC1412P..$1.25

BIMOS Operational Amplifier RCAs New CA3140 combines the advantages of high-voltage PMOS transistors with bipolar transistors on the same chip. Pin compatible with the popular CA3130 and directly replaces, in most cases, the widely used 741. Input impedance is, get this, 1.5Tohms, with 10 pA input current - how do you measure that?
CA3140T (TO-5 can).....Cheap...$1.10
20 page booklet of specs.....60



HIGH VOLTAGE, High Speed NPN Switch. Brand new type for use in switching inductive loads such as switching regulators, inverters, motor controls, solenoids/relays and deflection circuits.

	MJE13002	MJE13003
VCEO(sus)	300V	400V
VCEV	600V	700V
IC(cont)	1.5A	1.5A
(peak)	3.0A	3.0A

Packaged in the 77-03 case(TO-126), these little units pack a bunch of performance in a small space at the right price!
MJE13002.....$1.60 MJE13003.....$2.09

ULTRA SONIC TRANSCIEVER. LM1812 is a special IC containg a 12W transmitter, selective receiver, noise rejection circuitry, display driver and keyed modulator. Use in Sonar, burglar alarms, liquid level control, direction control for model submarines, etc.
LM1812.....$9.15. Specs and apps....60c

FLUID LEVEL DETECTOR. LM1830 integrated circuit compares external probe-toprobe resistance with a reference resistor. Use as water level detector or with any polar fluid. Snake detector can be made by substituting photo cell for the fluid probes....etc.
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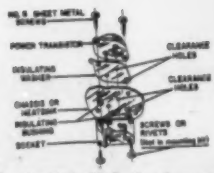
24 PIN IC SOCKET. Rugged, extra quality socket made by Robinson-Nugent. Heavy gold plated contacts. Body is 2 piece riveted construction. Can be soldered into PC board, or body mounted to chassis through 2 counter sunk holes in body. RNS-2403....Extra special ad price..... 2/88c

BALUN CORES "Binocular" ferrite core for use in winding balun transormers for transmitter outputs, antenna matching, etc. .55" long X .5" wide X .3" thick with .125" dia holes. FBC-2760.....10/$2.00

TIME DELAY MODULE. 115VAC input, 48VDC delayed output. Will drive relays, lamps, etc. 115VAC relay up to about 5W coil works perfectly with this unit. Delay is adjustable from about 2 sec to over 1 minute.
TDM-0132.....$2.95

LED's. Brand new by Monsanto or H.P. Prime Parts!!! Available in green or amber. Any Mix.....8/$1



MK-20 Mounting Kit for TO-3. From famous maker of power devices and mounting hardware. Contains wafer socket, drill templates, teflon bushings, mounting screws and anodized aluminum insulator for good heat conduction.
MK-20.....20 Kits.....$3.88

SPDT DIP SWITCH. Same as our very popular GRAYHILL DIS-76BXX series except contacts are SPDT. Fit DIP hole pattern. Two sizes. Last 2 digits indicate number of switches. DIS-76C02...$3.75 DIS-76C04.....$4.30

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LM399H..... $5.95

OUTDOOR SPEAKER. A quality 5" horn speaker by CULVER. 8 ohm, 10W! CES-8.....$11.95ppd

NI-CAD BATTERIES. Brand New Union Carbide rechargeable 6.25V, 400mAH battery packs. Long color coded wire leads. NCB-6252.....$3.25, 4 packs..$12.00

COAX Quick Disconnect Adapter. Converts PL259 into a push on quick disconnect for UHF type jacks. Simply screw PL-259 into the threaded jack. A real time saver for test and alignment of RF equipment, patch panels, multiple antennas, etc. F71-064.....$2.29

SUPER SMALL REED RELAY
Only 3/16" dia X 3/4" long. SPST N.O. contacts rated 1 amp ! Coil is 12VDC at only 8mA--5/8" wire leads for P.C. or terminal strip mounting.
RRY-372-1A.....$1.19

HIGH VOLTAGE SILICON NPN
2N6593 is a minimum 250V BVCED High Voltage amplifier transistor designed for horizontal drive applications, high voltage linear amplifiers, and high voltage transistor regulators. In the plastic tab duo-watt package-handles 2 watts in free air. Typical Ft is 100MHZ. Use this one in your Keyer---
2N6593.....$2.06

MINIATURE SPEAKER. Tiny, football shaped. Only 1-1/8" X 2-3/8" X 3/4" high. 8 ohm V.C. 200mW.
Miniature Speaker.....$1.49, 3/$4.00

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CONTINENTAL SPECIALTIES CORPORATION

INTRODUCES

The 4th in its Series of I.C. Test Clips

PC-40

LOWEST PRICED 40-PIN CLIP IN INDUSTRY

only $13.75 --- lowest priced 40-pin IC Test clip made today.

DIGITAL D.C. VOLTMETER.
Miniature self contained portable meter in high impact plastic case. Only 4½ oz - tuck in your shirt pocket or wear it on your belt. Easy to read display is close to point of measurement. No need to turn your head and risk shorting the circuit.
Press to read switch extends battery life.
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.Auto Decimal
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.Ranges 0 to 19.99V
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Only 1" X 1½" X 6 3/4"
Model 180 DVM.....$79.95
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SPEEDY BEND LEAD FORMER. One of the simplest and handiest tools in your shop. Bend ¼ and ½ W resistors, diodes and small caps on .4" to 1.5" center graduated every .05". Radiused edges give perfect bend radius on leads.
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CMOS STOPWATCH CHIP.
INTERSIL ICM7205IPG has on-chip oscillator and 6 digit direct drive capability. All you add is crystal, trimmer, battery, switches and LEDS. Has START/STOP, TAYLOR or SPLIT modes. 59min, 59.99 sec range. Low battery indication. ICM7205IPG..$19.95. Data... 90c
Crystal for the above.....$4.95

Miniature 50 Ohm Coax. RG-174/U is ideal for use in portable, QRP, test equipment, etc. BRAND NEW from famous maker. Only 1/10" diameter.
RG-174/U.....10'/ $ .95

TO-3 Power Device Heat Sink. For single TO-3 transistor or regulator. U shaped gold alodined finish. 1½"X1½"
AHS-103GA.....5/$1.00

DTL INTEGRATED CIRCUITS. Use DTL anywhere you use TTL when you don't need the high speed. DTL does not produce the switching "notch" noise as does TTL. In many cases the pin-outs are identical so you can plug in DTL directly. Numbers in parenthesis are pin compatable TTL. 946 (7400), 960 (7410), 930 (7420).
All are in 14 pin plastic DIP. DTL, any mix.....10/$1

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TOUCH TONE GENERATOR BY MOSTEK, MK5086N produces the dual-tone multi-frequency telephone dialing signals as used in TT phones and auto patches. Uses inexpensive crystal, 1 resistor and 1 capacitor. Both tones are internally mixed and buffered to a single output - simple! Two additional output switches can control timers, transmitter, mute receiver, enable audio amp, etc. Uses our Chomerics keyboard. Comes in 16 pin plastic DIP.
MK5086N.....$8.95...Crystal for MK5086N..... $1.90
Specs for MK5086N 80c.
Kit of parts including etched and drilled P.C. board and one of our Chomerics keyboards.....$19.95

MC14412 UNIVERSAL MODEM CHIP
MC14412 contains a complete FSK modulator and de-modulator compatible with foreign and USA communications. (0-600 BPS)
FEATURES:
- .On chip crystal oscillator
- .Echo suppressor disable tone generator
- .Originate and answer modes
- .Simplex, half-duplex, and full duplex operation
- .On chip sine wave
- .Modem self test mode
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- .Single supply
  VDD=4.75 to 15VDC - FL suffix
  VDD=4.75 to 6 VDC - VL suffix

TYPICAL APPLICATIONS:
- .Stand alone - low speed modems
- .Built - in low speed modems
- .Remote terminals, accoustic couplers

MC14412FL..... $28.99
MC14412VL..... $21.74
6 pages of data..... .60
Crystal for the above.....$4.95

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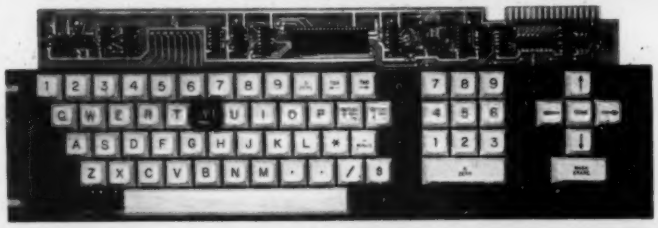

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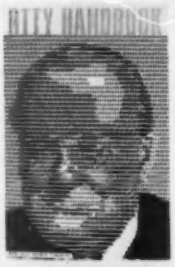

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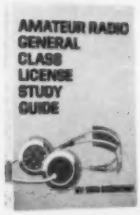

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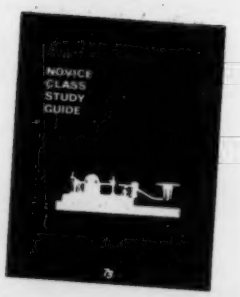

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December, 1976

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73 staff

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12/76

EDITORIAL BY WAYNE GREEN

from page 178

Meet Fran Dillon, who handles invoicing for subscriptions and orders for books, tapes and such items. As more and more of this routine is taken over by the slowly expanding computer system at 73, Fran should be able to devote more time to expanding the Radio Bookshop service. Fran also helps with sales and inventory records, a necessary part of keeping things moving smoothly.

Virginia Mammone helps with the pasteup of type to make up the pages of articles in the magazine. This is very exacting work, for each block of type must be set in precisely right . . . if it is off even a hair it looks crooked to the eye on the pages. Once the pages are pasted up, they are made into negatives and printing plates are made from the negatives.

Susan Mikula helps with bundling the piles of mail that get sent out every day. Note the mail trays behind her. Mail for each zip code center has to be sorted out and bundled.

Here's Richard Force WB2QYV/1, who's editing and organizing the new books which are coming from 73 . . . and there are a lot of them in the works, such as three more test equipment handbooks . . . a new Novice Study Guide . . . a new Repeater Atlas . . . General Class Study Guide . . . RTTY Handbook . . . and many more.

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	3	3	3	3	3	7	14	14	14
ARGENTINA	7	7	7	7	7	7	14	14	14	14A	14A	14
AUSTRALIA	14	7B	7B	3B	7	7	3B	7	14	14	14	14
CANAL ZONE	7A	7	7	7	7	3A	7A	14	14A	14A	14	14
ENGLAND	7	7	7	3	3A	3A	7A	14	14A	14	7	7
HAWAII	14	7B	7	3	7	7	3	3B	7B	14	14A	14
INDIA	7	7	7B	7B	7B	7B	7A	14	7B	7B	7B	7
JAPAN	14	7B	7B	7	7	3	3	7	7B	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	14	14A	14	14
PHILIPPINES	14B	7B	7B	3B	3B	3	3	7	7	7B	3B	7
PUERTO RICO	7	7	3	3	3	3	7A	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7B	14	14	21	21	14	14
U. S. S. R.	7	7	3	3	7	7B	7B	14	14	7B	3A	3A
WEST COAST	14	7	7	3	7	7	7	7A	14	14A	14A	14

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ARGENTINA	14	7	7	7	7	7	7	14	14	14A	14A	14
AUSTRALIA	14A	7B	7B	7B	7	7	3B	7	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	14A	14A	14	14
ENGLAND	3	7	7	3	7	7	7	14	14	14	7B	3B
HAWAII	14	7B	7	3	3	3A	3	3	7	14	14A	14
INDIA	7	7	7B	3B	7B	7B	3	7A	7A	7B	7B	7B
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PUERTO RICO	7A	7	7	7	7	7	7	14	14A	14A	14	14
SOUTH AFRICA	7A	7	7	7	7	7	7B	14	14A	14A	14	14
U. S. S. R.	7	7	3	3	7	7	7B	14	7B	7B	3B	3B

WESTERN UNITED STATES TO:

ALASKA	14	7	7	3	3	3	3	3	3A	7A	14	14
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AUSTRALIA	14A	14	14	7B	7	7	7	3B	7A	14	14	14
CANAL ZONE	14	7	7	7	7	7	3A	14	14	14A	14A	14
ENGLAND	3B	7	7	3	7	7	3B	7B	14	14B	7B	3B
HAWAII	14A	14	7	7	7	7	7	3	7	14	14A	14A
INDIA	7B	14B	14B	3B	3B	7B	3B	3	7	7	7B	7B
JAPAN	14A	14	7B	3	3	3	3	3	7	7	7B	14
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U. S. S. R.	7B	7	3	3	3	7	3B	3B	7	7B	3B	3B
EAST COAST	14	7	7	3	7	7	7	7A	14	14A	14A	14

A = Next higher frequency also may be useful
B = Difficult circuit this period
N = Normal
U = Unsettled
D = Disturbed

1976		DECEMBER				1976
SUN	MON	TUE	WED	THU	FRI	SAT
			1 N	2 N	3 N	4 N
5 N	6 N	7 U	8 N	9 N	10 N	11 U
12 U	13 D	14 U	15 D	16 N	17 N	18 U
19 N	20 N	21 U	22 N	23 N	24 N	25 U
26 U	27 D	28 U	29 D	30 U	31 U	

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A25	C3	E1	H2	K9	N4	S2	T6	W9
A21	C21	E9	H3	K1	O2	S21	T1	W7
A26	C5	E3	H11	K3	O3	S1	T2	W2
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